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The Best Form of Curve for Gear Teeth Profiles.

A valued correspondent recently asked us to obtain and publish statements of the preferred practice of leading constructors in connection with spur-gear-teeth profiles, and we present below, in abstract, the replies received from such constructors in answer to a uniform letter of inquiry sent to each one.

FROM HUGO BILGRAM.

Since epicycloidal gear wheels can run smoothly only if the distance of centers is correctly adjusted, so as to bring the pitch lines in contact, while the same condition is not an essential requisite in involute gearing, I consider the latter form to be the most practicable in machine construction, and never use epicycloidal gears myself. I have adopted the angle of 15 degrees for regular work and 20 degrees for special cases.

When the pinion of a pair of gears with involute gearing has a low number of teeth, the teeth of the wheel come into interference with the flanks of the pinion. This may be avoided by two methods. The first consists in reducing the addendum of the teeth of the wheel and, in order to maintain the normal hight of the teeth, increasing the addendum of the pinion correspondingly. The second method consists in increasing the angle of obliquity, and for these cases I have adopted the 20 degree angle. The first of these two methods is to be advocated when the pinion is the driver, the second when the wheel is the driver. The reason for making this distinction is the fact that the loss of power from friction is greater while the point of contact is approaching the pitch point than while receding from it. The change in addenda changes the angles of approach and recess, and if the wheel is the driver the angle of approach would be increased, which would be of disadvantage.

The usual objection to involute gearing—the crowding apart of the shafts—is untenable. Epicycloidal gearing is free of such "crowding" only while the point of contact is at the pitch point; in other positions the direction of force is more or less inclined, and accordingly equally "objectionable." But as a matter of fact the bearing of the shaft must resist a pressure equal and parallel to the pressure transmitted by the teeth, and since a slight inclination can reduce the leverage of force only by a few per cent. and accordingly increase the pressure but a trifle, the excess of bearing-pressure in involute gearing as against that in epicycloidal gearing is too insignificant to be seriously considered.

FROM THE BOSTON GEAR WORKS.

We are so busy that we cannot at present make any extensive remarks on the different styles of curves used in forming the teeth of gears, but we would say in a few words that the involute form appears to be the favorite to-day in the market. Where we furnish one gear with epicycloidal teeth, we furnish 1,000 with the involute form. Our opinion is that the involute form of tooth, if correctly and accurately cut, will usually give satisfaction. For an all round gear we are in favor of the involute style, on account of its strength, interchangeability and cheapness of construction. We think there are special cases where the epicycloidal form gives better satisfaction, especially in the case of a small pinion running with a rack or very large gear. In regard to the angle of obliquity, we would say that we use the Brown & Sharpe system almost entirely. Small pinions having less than twelve teeth should have an angle of 20 to 22 degrees; otherwise the tooth flanks will be altogether too weak.

We find the tendency of our customers in ordering pinions with less than fifteen teeth is to have them made of steel. In this way the teeth of the pinion with smaller roots than the teeth of the gear are compensated by the use of the stronger material. There is no doubt that the epicycloidal form of tooth in many cases will give results which are satisfactory, and by some firms it is used almost exclusively. Most of the printing machines to-day have this form of tooth.

FROM THE BROWN & SHARPE MANUFACTURING COMPANY.

The article on page 214 of our catalog will perhaps be an answer in part to your questions.

We can only add that the epicycloidal system, though theoretically correct, does not from a practical standpoint possess any advantages over the involute; and we, in our practice, use the involute exclusively, and recommend it to others if our opinion is sought.

The catalog page referred to reads, in part, as follows:

It is well known that involute gears can be made of different systems, or of different angles of obliquity or pressure. In the system proposed by Professor Willis about fifty years ago, which we adopted thirty years ago, the angle of pressure, or obliquity, is 14½ degrees. Twice this angle is the familiar angle of a worm-thread tool. Gears made upon this system are thought to crowd less upon their shafts than those having a greater angle of pressure. If, however, a gear, or pinion, has fewer than twelve teeth, this angle may cause their flanks to be undercut, and in consequence weak, in order to clear the faces of an engaging gear.

Hence gears that are to do heavy work may require a greater angle of pressure than 14½ degrees, if they are to run with pinion of fewer than twelve teeth.

FROM THE FELLOWS GEAR SHAPER COMPANY.

We find little demand for the epicycloidal form of tooth for cut gearing, it being principally confined to the class of work where a rotary motion is transformed to a lineal one, as in driving a planer platen, where it is claimed that the involute form of tooth does not produce satisfactory results. It is stated that with this form of tooth the platen has a slight tendency to rise as each tooth comes into contact with the rack. As theoretically the angle of thrust of the involute tooth is constant, and that of the epicycloidal is variable, it would seem that the former would give the better results of the two.

As to the angle of obliquity, it is our *practice* to "follow the crowd," using principally the angle of 14½ degrees. Our only exception is in the case of a small pinion driving a large gear. Our system of generating the tooth form allows us, by varying the diameter of the blanks slightly, to produce a pinion that is very much stronger than the standard construction. The angle of thrust in this case depends entirely upon the size

of the larger gear, and by a proper porportion of the blanks can be kept low.

Our *preference* is decidedly in favor of a greater angle, and we would suggest 18 or 20 degrees.

FROM THE GLEASON TOOL COMPANY.

It is our observation that involute teeth have the advantage of running correctly even when the distance between centers of gears varies slightly from that computed for.

But our experience shows that cycloidal teeth are better for a pinion with a few teeth meshing into a considerably larger gear.

We use the 15 degree involute on spur gears up to 1 diametral pitch. For coarser teeth we use a cycloidal system.

FROM GOULD & EBERHARDT.

Experience has proven the involute tooth to be the best for universal practice, for a multitude of reasons, which could be elaborated at great length, chief among which might be mentioned it allows gears to run at center distances that vary while in motion. In general, uniformity of action, minimum friction and thrust on bearings, strength and symmetrical appearance are winning points for the system.

FROM R. HOE & CO.

A greater part of our gearing is made with the epicycloidal curve, although for certain purposes we use the involute.

FROM THE PRATT & WHITNEY COMPANY.

We have found that in order to make interchangeable involute curve teeth from a pinion of twelve teeth to a rack, a rack of 15 degrees angle on the side with the points slightly curved (see Grant) and the corner at the base of the tooth filled in, is about right. We have followed the experience and the theories of others somewhat in this respect, and in constructing a machine for making the formers the cutting tool was so made that it left the slight curve on flank and face of tooth. The machine has been tested and we find that a rack and gears of any number of teeth down to twelve teeth will perfectly interchange. We believe they will also interchange with Brown & Sharpe's and Grant's.

There is no doubt that the involute form of gear tooth is gaining ground; yet we have customers that prefer the epicycloidal form.

FROM WILLIAM SELLERS & CO.

About ten years ago, when it became necessary to revise our cutter forming machine for cycloidal teeth, we took occasion to study anew the comparative advantages and disadvantages of the cycloidal and involute systems, and as a result of the investigation then made we abandoned our previous system in favor of an involute system having 20 degrees obliquity. This great obliquity was so far beyond the limits of common practice that we hesitated at first about making such a radical departure. At the same time we knew the angle should be still greater to avoid interference in certain cases.

Our experience with involute gearing has been generally satisfactory, but, like other systems, it has its limitations and defects which cannot be ignored. We have not had any trouble whatever from the extreme obliquity adopted, and our only regret now is that we did not follow our original conviction to make this angle still greater. The success of the involute system depends upon the perfection of the smallest pinion contemplated, and when this is assured larger gears become an easy matter to produce.

It is desirable, in many cases, to obtain large reductions in gearing, that the number of teeth in the pinion should be as small as possible, and in considering the obliquity adopted we fixed our attention on a twelve tooth pinion as one limit of an interchangeable system, and a rack as the other limit, internal gearing being impracticable to produce with rotary cutters.

At an obliquity of 20 degrees, sixteen is the smallest number of teeth that will engage with a rack without interference, while at an angle of 15 degrees the smallest number is thirty-one. Our twelve tooth pinion has therefore some interference, although much less than that of the common 15 degree system. Nevertheless, a small amount of it, even when apparently inappreciable, cuts away a considerable part of the arc of action, and this loss becomes painfully apparent when gears are run at high speed. We have had no trouble with gears of fifteen teeth and over, and as an improvement on our system we would suggest an angle of 22½ degrees. This, being a quarter of a right angle, is easily constructed, and will bring the theoretical range of the system so near to twelve teeth as to meet all practical requirements.

The thrust on bearings from obliquity of action we think has been very much exaggerated. What the bearings are for is to carry the drive on the teeth, no matter in what direction it may come. When the drive is normal to the line of center, an impracticable condition for any form of gearing, we have the least pressure on bearings, which may be used as a unit to measure the pressure in different actual cases. Thus it appears that for involute gearing the bearing pressure is measured by the secant of the obliquity. For the common 15 degree system it is 1.0353 and for our 20 degree system it is 1.0642, while for the 22½ degree system here suggested it would be 1.0824. The thrust on the line of centers is proportional to the tangent of the obliquity, and this increases much faster than the bearing pressure, which is the only factor of importance in connection with the obliquity of action.

The conditions of interchangeability and a twelve tooth pinion require a large angle of obliquity, but when these conditions are not imposed the field is open for any shape and proportions of tooth desired. For special gears at high speed we would endeavor to obtain a long arc of action, and our choice would probably be radial flanks with epicycloidal faces, while for other gears at slow speed and very heavily loaded we might be tempted to reduce the usual standard of length. In either case, however, the interchangeable feature would be lost, and it is this that will hold the addendum to its commonly accepted value between .3 and 1-3 pitch, no matter what may be said about the merits of long and short teeth.

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Exclusion of Foreign Students from Prussian High Schools.

A Berlin despatch dated February 26 says:

"A decree was issued by the Government on Thursday last forbidding the future attendance of foreigners in the machinery and engineering department of the Berlin Technical High School, and it has caused much consternation among the foreign-born students in Germany, as it is believed to be the forerunner of others excluding them from all similar institutions.

"The Liberal newspapers condemn the decree, and express the belief that other countries will retailiate by a similar illiberal policy. The Conservative semi-official press, however, applauds the decree, and hopes it will be followed by others of a more sweeping and general character. The 'Deutsche Zeitung' remarks:

" 'At the non-Prussian High Schools at Munich, Dresden, Stuttgart, Carlsruhe, Darmstadt and Brunswick there are 1,200 foreigners out of 8,682 students. We hope that, as the foreigners use their knowledge to the detriment of German industry, the non-Prussian Governments will forthwith exclude them.' "

So far as America is concerned we think we shall be able to stand the effects of this decree without serious inconvenience. It may lead to the improvement of some of our technical schools in some respects, but we think Americans can get along very well without what German engineering schools can give them. If our workshops were to be closed to German students it would be a much more serious matter to them probably, though it is doubtful if such exclusion would benefit us.

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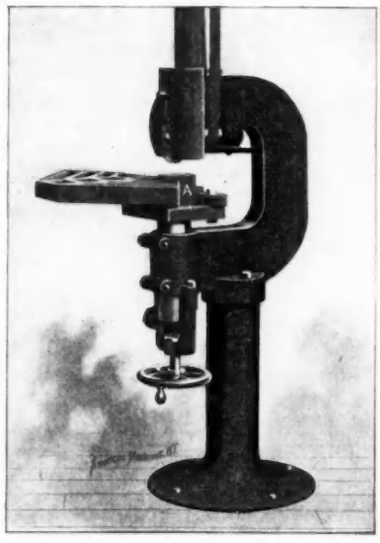
It took seventy shots at close range, including several from a 9.2-inch gun, before the British cruiser "Edgar" could sink in the Red Sea a defenceless, derelict tank steamer.

A New Surface Grinding Machine.

The accompanying half-tone and detail engravings illustrate a machine which embodies a new principle in surface grinding. It is the design of Mr. E. J. Armstrong, of the Ames Iron Works, Oswego, N. Y., in which works two of them



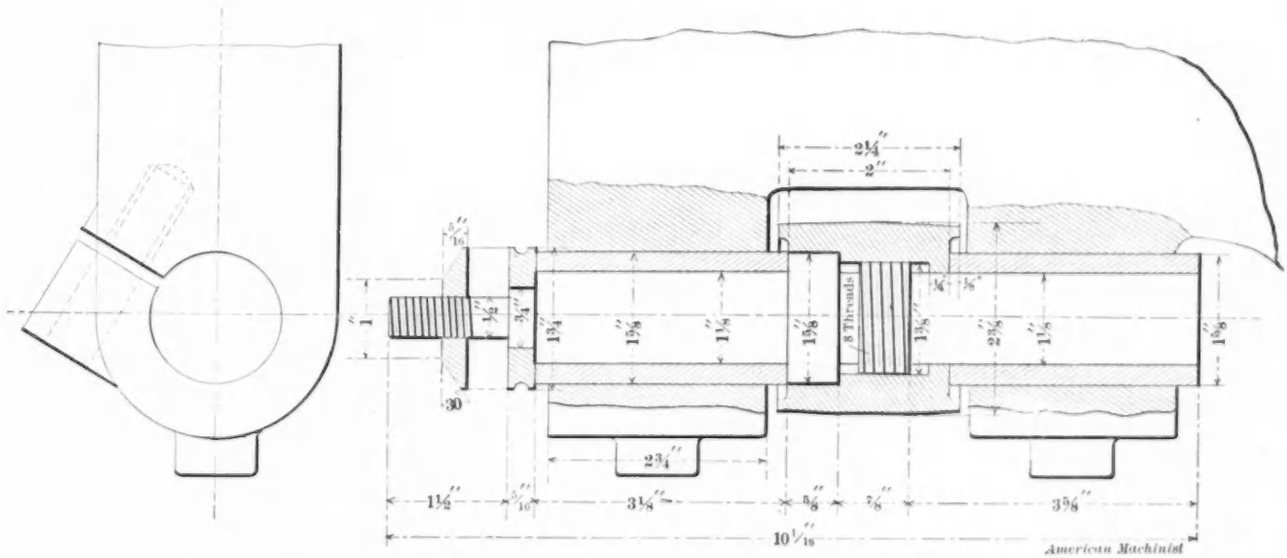
A NEW SURFACE GRINDING MACHINE.

effect of the heat generated is to expand the surface being ground and hence to warp the piece—the convex side being toward the wheel. If the work is bolted to a moving platen, or if it is moved by hand about a fixed plane surface on which it rests, the result of this warping causes the central portions of the work to lift from the supporting surface, adding considerably to the difficulty of doing really accurate work, if not in some cases actually preventing it.

In Mr. Armstrong's machine the main support of the work is the skeleton plate seen in front of the emery wheel. The office of this plate is, however, to carry the weight of the work and to make its movements substantially parallel only. It will be seen that it does not surround the wheel, being entirely on one side of it and fan shaped as well. A block *A* will be seen forming part of the skeleton casting. Through this block and immediately below the wheel is inserted a pin, the identity of which is lost in the photograph in consequence of it and the upper surface being polished. This pin is connected with the hand wheel seen below, by which it can be made to project more or less through block *A*. When grinding it so projects by a few thousandths of an inch, and it forms the immediate support of the work at the

In thicknessing a slide valve, for example, the first operation, after planing both sides, is to scrape one side truly flat. The valve is then brought to this machine, and by it the other side is ground down by moving the valve by hand below the wheel until the valve is within a quarter thousandth of the final thickness. When the grinding is completed the valve is of uniform thickness, though warped out of flat on both sides by the heat. On cooling down it becomes again flat and a slight amount of scraping on the ground side completes it for use. It will be seen that the office of the machine is to get rid of the surplus metal on the second side by a quicker method than by hand scraping. A similar method is followed in making piston rings. As the sleeve casting is put in the lathe, the outside surface only of a ring is faced, the other being merely cut off with a parting tool, when the second side is ground on this machine.

The hand wheel below enables the pin to be adjusted to determine the thickness of the work and to compensate for the wear of the emery wheel. This hand wheel is provided with a graduated disk divided to read to thousandths. When with continued wear of the wheel the pin projects farther above block *A* than is desirable, the entire skeleton plate is



DETAIL OF SPINDLE AND BEARINGS OF SURFACE GRINDING MACHINE.

are kept in active use. Its office is the grinding of balanced slide valves, parallel distance strips for the valves, piston rings, and such other pieces as are required to be truly parallel. The leading novelty in the design of the machine lies in the means adopted for avoiding the effects of the heat generated by the grinding. It is well understood that when a flat piece is ground on one side the

point where the grinding is being done. The machine will be seen to be in effect a stationary caliper, in one leg of which an emery wheel is inserted and the work put through it must be brought down to a uniform thickness regardless of the warping effect of the heat—the edges of the work curling downward in the air without disturbing the point where the grinding is going on.

raised to a new position and secured by means shown in the picture.

The skeleton form of plate is used to avoid the accumulation of emery dust. The wheel is fitted with a hood connected to a system of exhaust pipes and a fan. A neat wrinkle is found in connection with the exhaust pipe, which is fitted with a gate connected to the belt shipper in such a way that when the wheel

is in motion the gate is open, and when standing still it is shut.

Mr. Armstrong informs us that it is easy to grind pieces with this machine so nearly parallel that no lack of parallelism can be detected with the micrometer.

The small detail engraving shows the construction of the spindle bearings which Mr. Armstrong has found best adapted to securing true running of the spindle at the high speed necessary. The bearing will be seen to be a plain babbitt bush, not split, but held in a bored casing, which is split and provided with a clamping screw. With the machine in constant use these bushes require renewal about once a year.

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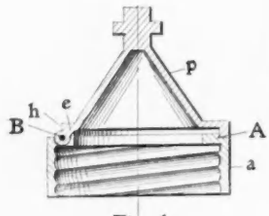

Fig. 1

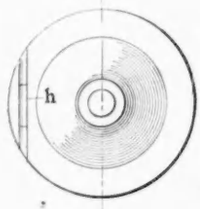

Fig. 2

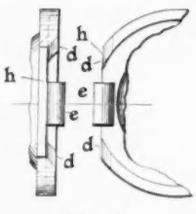

Fig. 3

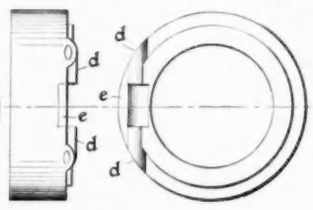

Fig. 4

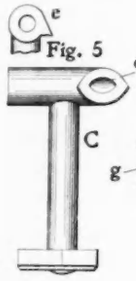

Fig. 6

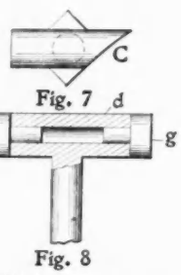

Fig. 8

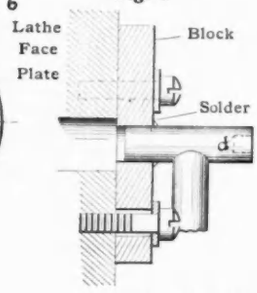

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Fig. 9

A Mustard-Top Mold, and the Process of Making It.

BY A. H. CLEAVES.

This mustard-top mold was one of my contract jobs, and if I had never had but one to make I guess I should have gone lame. As it was I got a lesson out of it in self-thinking, which the manager intended (I being an apprentice), that was worth more to me, really, than any money I might have made out of it.

Looking first at the mustard-bottle cover itself, a fair idea of which may be obtained from Figs. 1 and 2, it is easy to see that the principal feature in the whole thing is the joint.

I have noticed similar articles since then for syrup pitchers, etc., and the last one I examined had a fault quite natural to any of them of not shutting squarely, although in the one I speak of there was no ledge to match, as at *A*, Fig. 1, and the pin hole in one of the joints had been made loose, in order, seemingly, to get the cover to shut at all. The lid is apt to shut with opening in the back, or gaping in front, or with sides not opposite in the two parts. The cap, and the ring which screws on to the bottle, being cast in two molds, the trick consists in having the pin holes *B* in the two pieces line when the latter shuts exactly.

For a further and clearer illustration of the joints in the cover itself attention is called to Figs. 3 and 4, the former showing the top joint and the latter the bottom one. These figures, with the corresponding parts in the cuts explaining the molds, I trust will make the description quite clear.

The Figs. 5 to 14, illustrating in detail the joint-work in the molds, may be explained as follows: Figs. 5, 6, 7 and 8 are different views of the pieces used in the molds for forming the spaces in the joints, and closing the ends of the joint openings in the molds to prevent the escape of the metal. They were known as "knuckles" in the shop.

The letter *C* shows the complementary parts in the different views under that letter as referred to now. In Fig. 18 two such knuckles are seen closing up the joint at *c c*, and in Fig. 17 two half spaces in the lower part of the ring mold match them. The curved ends of *c c* form the end of joint *d d*, Fig. 4. The pieces like *d*, Fig. 8, stop the metal and form the spaces *d d* in Fig. 3 (see Figs. 15, 16). In Fig. 5 *e* is a knuckle that forms the space *e* in the lower piece or ring, Fig. 4. The angle edge on Fig. 5 permits the metal to draw (see *e*, Fig. 22). In Fig. 3 *e* is seen as the solid part of joint, and a similar draft for the metal in this case is provided for, as shown at *e*, Fig. 12, and *e*, Fig. 16, where that part of the core *f* containing the segment of a circle is filed out in the center to cast the angle seen at *e*, Fig. 1.

In Fig. 8, *g g* are hardened forms for filing down the center of the cylinder by, after the ends are turned off on centers. They answer more especially to keep the file from injuring the ends of the knuckle. The piece *h* is shown in many different places by that letter, and its effects must be understood by the figures. It stops up a part of the ring or sink turnings in one of the molds, as seen in Fig. 15 and Fig. 12, and in the mold forms the straight part of upper joint seen at *h* in Figs. 1 and 2, as well as the visible part of the circle in that part of the joint (see *h*, Fig. 2).

Figs. 10 and 11 help to explain the method of making this piece. Let *k* be

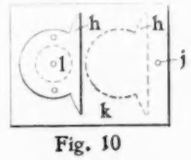

Fig. 10

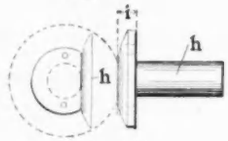

Fig. 11

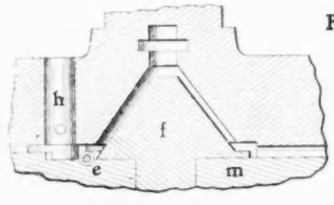

Fig. 12

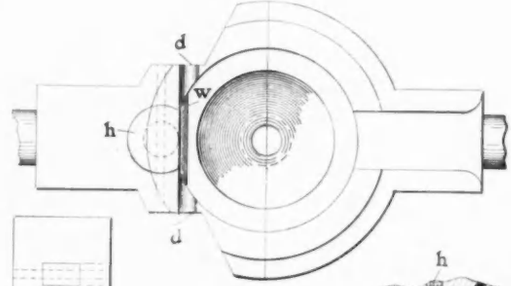

Fig. 15

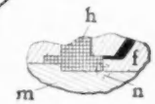

Fig. 13

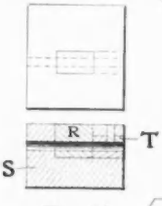

Fig. 14

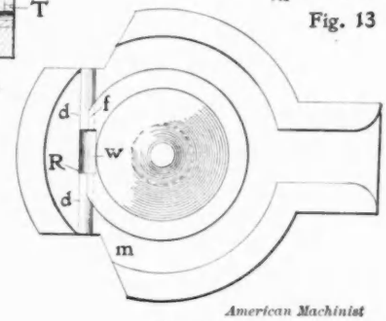

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Fig. 16

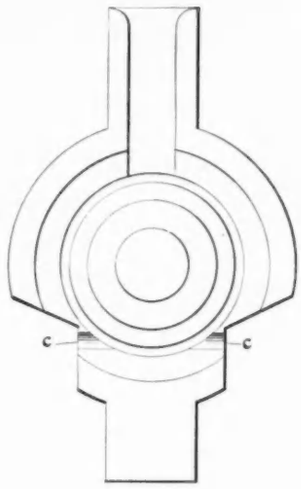

Fig. 17

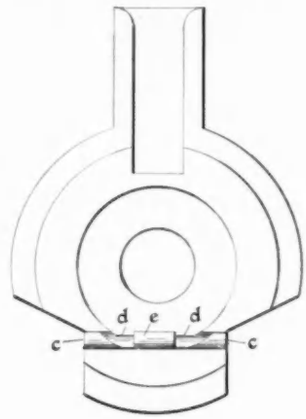

Fig. 18

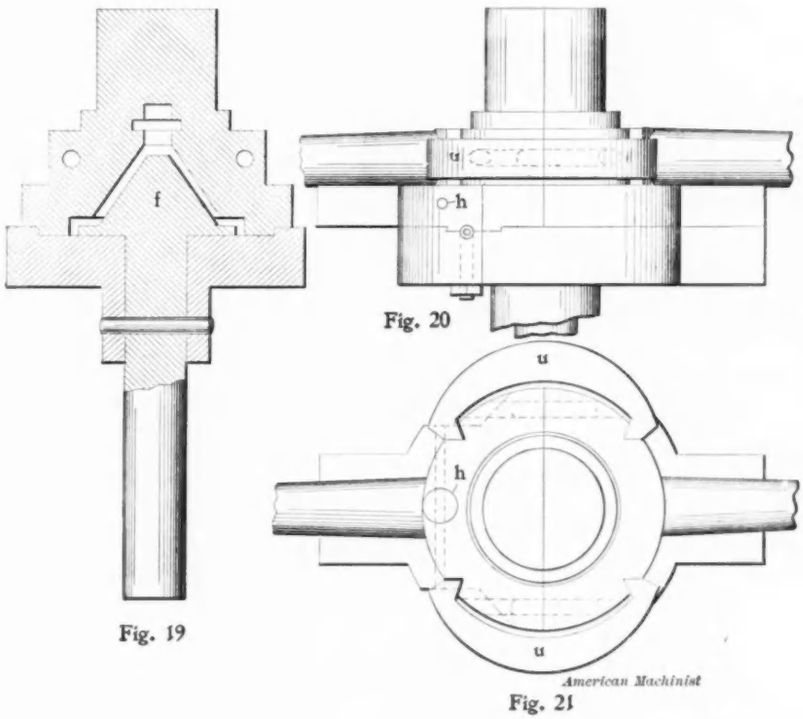

Fig. 19

Fig. 20

Fig. 21

a piece of good tempering sheet steel 1-64 inch or so thick. The point *j* corresponds with the center of mold, and *h* is laid out on this, as shown. Two guide pin holes are drilled in it. The center *l* used to test the piece up for boring out the hole shown by dotted line, which fits the shank of *h*, Fig. 11. Have the hole and outer circle correspond with teat and outside of a counter bore to be used in making a place for *h* in the mold. The centers *j* and *l* on the mold must be the counterpart of those in Fig. 10.

File out the profile of *h*, Fig. 10. Solder this on to any brass or steel plate, clamp to lathe face-plate, bore out hole with center *l* for tester guide. Then harden this templet between two flat metal blocks smeared with oil. Transfer the two pin holes to the piece of sheet steel left, and file out a second templet, like the first one, and shown by the dotted lines *h*, Fig. 10. Harden this like the other. Make a steel blank like *h*, Fig. 11, diameter like large dotted circle, and large part thick enough to produce *i*. Slip the templet with hole in it onto the shank of *h*, Fig. 11; transfer the pin holes in the templet to the blank clear through. Then pin the templets with this piece between them and file out the blank to the required form. When this is pinned, as shown, in the mold it can be turned on face and shoulder while held in the latter, as seen in Figs. 12 and 15.

Fig. 13 shows the straight edge of *h* and of *f*, and the surface of the mold part *m* in position to drill the joint opening shown by small dotted circle. This is before *f*, Fig. 16, is filed out in the center. See *m*, Fig. 16, and edge of *h*, Fig. 15. The sinks in the mold being fitted, the parts *h f m*, Fig. 13, are practically solid and the hole at the dotted circle *n* is drilled with the parts securely held together.. To get the pin holes in the joint *B*, Fig. 1, to line exactly, complete both molds, with the exception of the pin holes in the knuckles in the cap mold, or in *d d*, Fig. 16.

The knuckles in the ring mold, Fig. 22, have holes made in them the first thing, as seen at *o*, Fig. 6, the end curve being made afterward. When the mold is ready to use (see Fig. 22), a wire is put in these holes in the knuckles, and the metal flows around the wire in the spaces to form the hole in the casting. Get a casting from the ring mold, Fig. 22, the joints having the holes in them. Then get a casting from the other mold, Figs. 19, 20, 21 and Fig. 3, without any hole in *e*, Fig. 3, of course. Any defect in the fitting of the two parts can now be remedied in the molds; and when this is done put *p* and *g*, Fig. 1, together and transfer through the holes in *d d*, Fig. 4, a hole into *e*, Fig. 3. This is in the metal casting *p*, Fig. 1.

Now, place this casting *p*, Fig. 1, back into the lower part of its mold *m*, Fig. 16. Have one of the knuckles *d* taken out, and transfer through this hole in *p*, Fig. 1, a part of the hole for the knuckle in the mold on the inner end of the same, say, *R*, Fig. 16. Take this

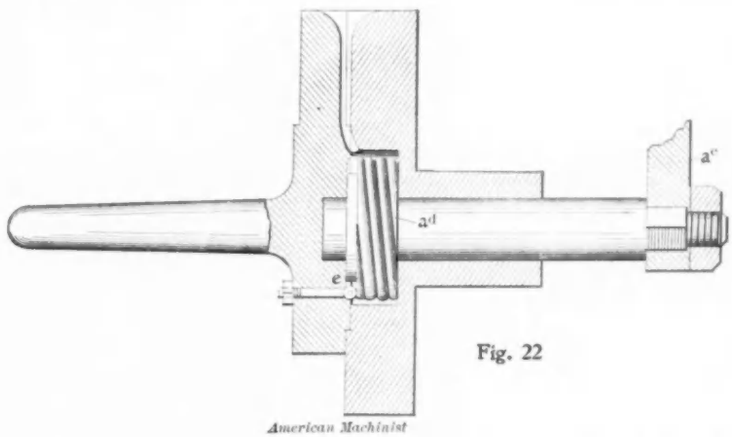

Fig. 22

knuckle out, put the other in and mark it in the same way. Then put the knuckles in a holder with solder, as shown at Fig. 9; test up true in a lathe by hole started, and drill and ream out the knuckle by holding the drill in a pin vise held in the hand while the work revolves in the lathe. I have mentioned this before, but it will do to repeat. Do not put the pin vise nor the drill in the same against the center in tailstock of lathe. Push with the hand, and with a true center in the work to start in the smallest drill will find its own true hole.

Fig. 14 is intended to illustrate a similar operation to the one last described, which I had occasion to use in another mold; the hole in the piece *R* to be transferred to the block *S*. I opened a hole at *T* and drilled through *R* into *S*, put a tight plug into *S* at *T*, and used the holes in *S* and *R* to guide the drill back through this plug. The hole in *R* was obtained, as in the other instance, from the hole in its complement; and the plug work in this case is as good as the solid metal. A pin is shown to prevent the plug from moving when hot.

In Figs. 20 and 21 two fork clamps are shown by *u*, which hold the double parts of cap mold together when used in casting. The notches which they enter taper a little to hold.

Fig. 23 shows a collar at *V* for holding the same parts together when in the lathe. The piece *W* is a ring rest for this kind of work, and is seen to better advantage in Fig. 24. The hole in *W* is made central with the lathe spindle to start with, but has play around the binding screws *x* for sure adjustment. This piece *W* also hugs the shoulder on the mold parts to keep the same up to the center, and must be square and true or parallel with face plate.

Fig. 25 is a view of a chuck that can be used on the lathe, as shown for facing off surface *y* dotted line, etc., or on drill plate, as suggested by clamps for drilling dowel pinholes *s*, milling sinks, etc. Drill holes in one part first, then place on top of the other and transfer.

The taper shanks held in the chuck

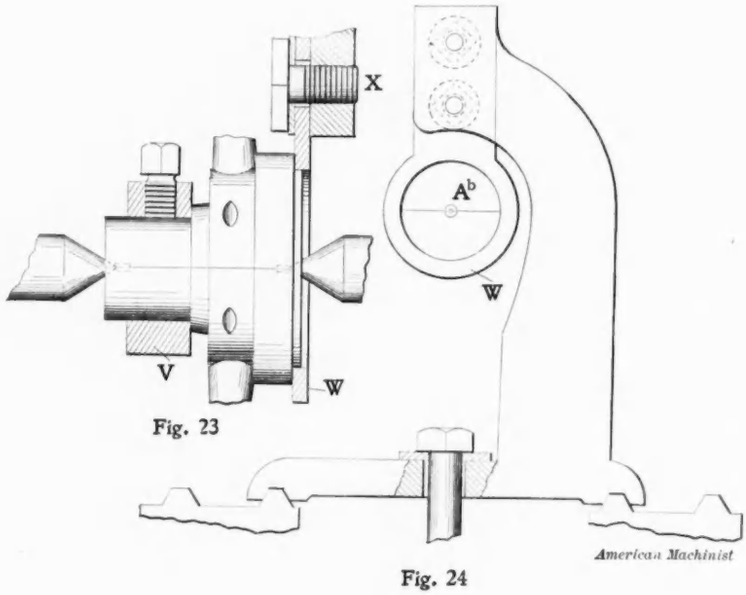

Fig. 23

Fig. 24

are also handles for the molder's use in casting, being covered with cloth or held in the same for protection from the heat.

The two parts of cap mold, after being dowel-pinned together, are centered

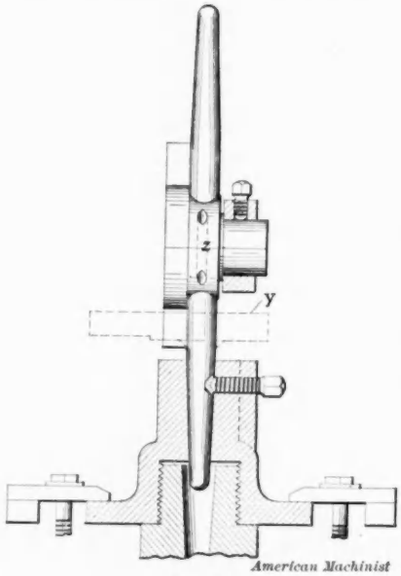

Fig. 25

as shown at *Ab*, Fig. 24, for turning shoulder preparatory to back-resting for the interior work. The back-rest frame, Fig. 24, is easily moved to examine the mold without changing the position of *W*.

In Fig. 22 *Ac* gives a clew to a handle or crank made *a la* hand-organ style for starting the screw-core *Ad* out of the casting. Fig. 9 gives a good method of mounting odd jobs quickly on a face plate. Several round brass blanks for driving work into or soldering it onto are kept handy. For central work they can be used as shown, Fig. 9. Being screwed onto face-plate with two or three screws, a hole then made in center, and the screw-holes in the block are opened to allow of adjusting work, like the knuckle *d*, slightly out of eccentric with the hole in its end.

In other cases the block can be held readily in any place on the face-plate with screws or clamps, while the work soldered onto it may be in any oblique position for work.

Chicago, Ill.

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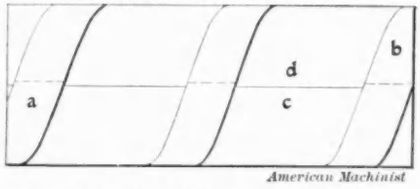
For Mailing Rolled Drawings.

We lately received a rolled drawing which was so free from all unpleasantness in the operation of undoing that it seems worth while to tell how it was done up, so that others may adopt it for the promotion of good feeling all around. The drawing was rolled up as small as was necessary, then heavy brown paper, a trifle wider than the drawing, was rolled around it several thicknesses, and to secure it a strip of the same brown paper was wound helically outside, as shown in the sketch, gummed at the ends and elsewhere, but not gummed along the line where the wrapper ended. The wrapper was not gummed at all, so that when a penknife was run under the helical strip at the dotted lines the wrapper unrolled at once. If this should ever be adopted for securing rolled manuscript we would have to regret ever having called attention to it, for rolled manuscript is an abomination.



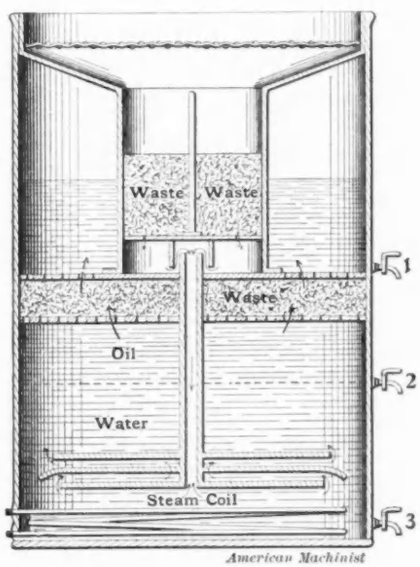
FOR MAILING ROLLED DRAWINGS.

▲ ▲ ▲

It is announced that the Russian Government has decided to adopt the metric system. The United States and the British Empire will thus soon be the only important countries which have not adopted the decimal system of weights and measures. An imperial commission has also been appointed at St. Petersburg to consider the best means of abandoning the Russian calendar in favor of that which prevails in other parts of the civilized world.

The Cross Oil Filter.

In calling attention to this filter, which is already in extensive use, and in offering a brief description of its operation, we cannot but feel that we are doing our readers, or at least some of our readers, an important service. In the more advanced and more prosperous shops oil is, as it should be, used in much larger quantity than formerly. The importance of efficient and constant lubrication has come to be generally recognized, and it is also found that the lubrication of cutting tools is as remunerative, and, for the best work, as necessary as the lubrication of the journals. In view of the quantity of oil now used, and the cost of it, some satisfactory means of purifying the oil, so that it may be used over and over, becomes an important economical feature in every manufacturing establishment. It saves money, and it promotes still further the liberal use of oil where its function is so important.



THE CROSS OIL FILTER.

Referring to the accompanying cut for a proper understanding of the filter, it may be best to first describe its operation. The filter being new and clean, with the filling of waste in place in the two places as indicated, and the steam pipe being connected to the coil at the bottom, clean warm water is poured into the top until it flows out of cock No. 2, or, if the water is cold, it may be warmed up by the steam coil. Pure oil is then run in until it rises to cock No. 1, and the filter is then ready for business. The oil to be filtered is poured in at the top in any convenient quantity. The wire grating at the top intercepts the larger chips at once. The waste in the upper chamber collects all the heavier impurities of the oil. The bottom of the small chamber below this body of waste is solid and some sediment collects upon it. The oil then moves, as shown by the arrows, past the baffle ring and down the central tube, spreading slowly outward in contact with the water, and the film of oil growing thinner as the periphery is approached, up over the edge of the first plate and under the edge of the second or central plate, which overhangs the other and is concave upon its under side. The flow is inward under this plate, and surrounding the central pipe are a number of holes through which the oil passes and then flows outward again under the upper plate. As it passes out from this plate the oil has become finely separated and mixed with the water, and as the water is warm the oil is limpid and becomes thoroughly cleansed. It still has to pass through the body of waste which extends all across the tank and finally collects in the annular chamber above, whence it is drawn off by cock No. 1 for use. The water in the body of the tank is not hot, but merely warm, and only sufficient steam is admitted to keep it so. The rate at which the percolation proceeds may be regulated by the quantity of waste used, and the tightness with which it is packed in the two receptacles. The water, which should be kept at about the hight of cock No. 2, may be drawn off, with most of the sediment, through cock No. 3.

The filter is in two separate parts. The tank proper has the steam coil in the bottom. The inside working parts are attached to a nickel-plated rim at the top and lift out all together, giving opportunity for thorough cleaning and for renewing the waste. The upper body of waste needs changing more frequently than that below, the rate in either case depending largely upon the condition of the oil passed through. The filter is made in six sizes, the capacities ranging from 3 gallons to 120 gallons per day. The makers are the Burt Manufacturing Company, Akron, Ohio.

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The Late Strike in England.

BY W. H. BOOTH.

Now that the English strike is over it may not be out of place to take a review of the same and endeavor to see whether any good can be learned from it. This is perhaps the more necessary when we consider that it was not a strike for higher wages, which at the time would have been granted on demand; neither was it a strike against any attempted reduction of pay. Professedly it was a strike in support of a demand for a week of forty-eight hours. But it was acknowledged by the secretary of the Amalgamated Society of Engineers—the principal trades union in England—that the "issue had been shunted onto the popular one of the eight-hour day." The real point at issue was the so-called machine question. This is probably a subject of which very little is known in America. First let me state how the strike began when the A. S. E. had made up their minds to have a fight. It began with a demand for the eight-hour day in London, the reason given being that men lived so far from their places of work that an eight-hour day was really necessary for London. If the demand was not complied with a strike was threatened. This threat was met by a counter threat of the Employers' Federation to lock out 25 per cent. of their employés, who were members of the unions, every week until all would be locked out. Both threats were carried into effect; three London firms were struck against and at once every Federated shop in England and Scotland locked out a fourth of its men who were unionists. This occurred about July 1, 1897, and every subsequent week saw additions to the ranks of the Employers' Federation, and a gradual extension of the lockout. The funds of the A. S. E., when the strike began, amounted to $1,750,000, and this was added to by levies upon such unionists as were still at work and by subscriptions from abroad, notably Germany; but foreign subscriptions never amounted to very much, and the general public at home never extended their sympathy to the strike, which was doomed to failure from the very start.

I have said the machine question was at the bottom of the trouble. Now, what is this machine question of which so much has been heard? The A. S. E. has for years steadily pursued a certain line of policy, a very aggressive policy, the outcome of which is reduction of output per man. Thus if a man is noticed to work at a rate too high to suit the ideas of the A. S. E. he is warned to abate his energies. The same thing happened with machines. Lathes were run below speed and output generally curtailed, while all kinds of annoying regulations were enforced upon shop managers. For example, no man was allowed to attend to more than one machine. If a laborer was taken from the shop floor and placed to work a machine he was forbidden, unless he was paid the full minimum rate of wages paid to skilled men. In some districts this sort of thing went on until the machines were rated, instead of the men. A certain slotter, for example, if worked, must pay so much a week, and machinery was sometimes kept idle by its owners rather than submit to the rates enforced for permitting it to be worked. No boy was permitted to work a machine unless paid full man's wages. No piecework was allowed. All these restrictions did not apply all round; they varied a good deal with the local delegate of the union; but speaking generally for the whole country, the rule was to so harass the management by the demands made from time to time that at last an Employers' Federation was formed on the Northeast Coast to com-

bat this power, and this Federation has since become national. In America, where a man may take charge of as many machines as he cares to undertake, it will hardly be comprehended that no man in England under trades union rules could attend to more than one. A case is recorded where trouble arose because a man left his lathe on a cut while he used the grindstone. This was taken as the working of two machines, and he was ordered to forego the habit. A man might be on a shafting lathe with a cut of 10 feet to run, but he must not run two such lathes. The A. S. E. claimed certain work as the sole right of its members. This claim was modified only by the allowance that if a man, or a boy, or any other man, as a laborer, did such work the union rate of wages must be paid. Necessarily the continued quarreling caused a large expenditure of funds, and the time came when the admission of a man to membership in the A. S. E. was not made conditional on his skill. Payment of fees and dues came to constitute membership and the quality fell off. Unskilled men got in, the drunken and the lazy, the men of bad character, all became members and lowered the tone of the society. Shirking work came as a second nature to such men. To run a lathe on a blind cut suited them to the ground. They drew good pay and discredited the society.

To such a pitch had matters been brought that when the lockout was made and work had to be carried on by apprentices, laborers and odd men the output from machines was increased 25, 30 and 40 per cent. The A. S. E. began to see that their members were not necessary, that they could be dispensed with, and the most urgent efforts were made to secure the interference of Government and the sympathy of the public. But it was generally perceived that the A. S. E. was working on an entirely wrong basis and that the province of trades-unionism was not to interfere in the management of workshops or say at what speed any machine should be run or what man should run it.

The argument of the trades unions has been for years that there is a fixed amount of work to be done and no man must do more than a certain share or there will be some men left with no work to do. In pursuit of this chimerical idea, which, of course, underlies the machine question, it has been rendered impossible to do certain classes of work in England. Let us take one example only, the direct-acting steam pump. Those in America are made on the repetition [duplicate] system by boys or "skilled laborers" very largely, who perhaps do the small work. There is a portion of the work which requires more skill, and for a hundred boys and men trained to do one thing only there are, say, ten better skilled men, either directly employed or, indirectly employed in the foundry or the tool factory. But English trades unionism has said No! You must not employ these boys at small wages. You must employ fully skilled men at full wages. Obviously, the articles cannot be made at the price, and the result of not allowing the employment of the hundred boys or laborers is to throw out of work the ten men who were making the machines and tools with which the boys worked and to stop so much foundry work and so much pig iron manufacture. There is no end to the ramifications from every piece of work done, and to insist on the employment of a skilled man under impossible conditions is simply to check trade. Under such loads as this the engineering trades have staggered along for years.

Obviously the machine tool trade has been a great sufferer. It is of very little use trying to sell a special tool to a man who cannot do justice to the tool unless he sets one man to attend to four of them. He has a dictator over him, who says "You must employ one man to each machine." "Very good," replies the man, "my old lathe, under the circumstances, will do as well. Of what use is a new and powerful tool to a man who has an old tool that will do, and does do, as much work as the new tool would be allowed to do."

Under such deadening influences is it to be expected that machine tool making should be anything but the humdrum trade it is? There is no incentive to improvement. It has been killed by the union demands. There are, of course, non-union shops, where a very different state of affairs prevails, and these, when they want automatic machinery, have frequently gone to America for it; and in these shops work is turned out at a rate that would surprise some Americans, who think all English shops are run under union rules.

However, to resume the record of the strike. When the Board of Trade had been importuned for some time to interfere in the matter, chiefly by pressure brought to bear by the A. S. E., a conference was called between the executives of the A. S. E. and of the Employers' Federation, and certain terms were practically agreed to. "But," said the men's leaders, "we must have our members' consent to the terms." The terms were submitted to a ballot of the men, with an accompanying circular which practically asked them to negative the terms, and the quarrel went on. There was a further conference, throughout which, as in the former case also, the employers resolutely refused to agree to anything which deprived them of full control in their own shops. It was made very evident in the course of these negotiations that the fight had all the time been fought on this so-called machine and shop management question. Everything was done to preserve to the trades union the fullest liberty of interference with shop management, and the eight-hour question was even stated to be of comparatively small moment. But the fight was really over, and the further delay, thus caused, only served to more thoroughly deplete the funds and to convert a defeat into a rout. Never had men been so badly advised, so grossly deceived during the fight and so cynically left to die in the last ditch as were the English engineers in this fight. In the end the men returned to work at the end of January, the strike having lasted seven weary months, and the men have been forced back all along the line, the principles of freedom all round having been established. On the reopening of the shops there were found to be many which were unable to take back a single man, a full complement of men having been got together during the strike, and other shops could take only a portion of their old staff.

During the strike many non-union men and also laborers had been out on strike in sympathy with the union men and had been paid strike pay by the union. This pay ceased almost immediately the strike terminated, and the men were left in the lurch. On the whole the men went back to work with none of that exasperation of spirit which was threatened, by their leaders, would be the case if the men lost. The employers also did not make a show of their victory. The truth is that the best of the men had realized that they were on a false tack; they realized that the so-called "bogey" of foreign and American competition required something more than half-hearted efforts to meet it successfully.

In the early days of the strike John Burns stated he would have the strike finished in a fortnight. He also stated that if the employers would go in for American methods they would be able to concede the eight-hour day. This talk about American methods showed that the man had absolutely no reliable knowledge of shop practice, either in England or America. The truth being that the very men he was egging on to fight were fighting against every endeavor to introduce the "American" system, which is understood to be the right of an employer to intrust his machinery to any man he cares to employ and the right of every employé to make as much money as he can. This is the kernel of the machine question, and it seems madness that any body of men should lose seven months' work in trying to enforce anything different.

A laborer may be naturally a mechanic and yet may have been debarred in early life from securing a training as a machinist. By trades unionism such a man, no matter how intelligent he may be, cannot rise beyond the position of a la-

borer, though essentially competent to earn more money in attendance upon automatic machinery. If as a laborer he earns $6 and his employer gives him machinery to attend, the employer was debarred from paying this man $8. Trades unionism said you must either employ a skilled man at $10 or you must pay your laborer $10, and you must not allow him to attend to more than one machine. Such a position could obviously not endure for long. It was an economic error of the A. S. E. to attempt to enforce it, and it was a strategic blunder, moreover, for it arrayed against unionism the large force of intelligent labor of the unskilled sort. One writer put the case of the laborer in a paraphrase of Shakespeare's passage "Hath not a laborer eyes, ears," &c. In fact, is not the laborer as one of ourselves, with his hopes, fears, affections, ambitions and his necessities perhaps, keenly developed for every extra dollar he can earn and from which he is debarred by what he regards as selfish, brutal unionism, which could not even show that the bettering of the laborer worsened things for the more skilled man? To condemn a man, no matter what he may be, to a fixed, unimprovable condition, is manifestly unjust and cruel. Unfortunately, unionism went "nap" on its claim to build a ring fence round its little monopoly, and so has perished temporarily in the ruin it invited. Very properly it will rise again from its ashes, but purified of its gathered encumbrances. In a country where, excepting the non-competing colonies of New Zealand and the Australias, the hours of labor are shorter than in any other country, it is not likely that the oppression of capital will become excessive. Trades unionism, properly conducted, is quite competent to deal with capital in such respects, and it is an obvious folly to undertake the management of workshops and dictate machinery speeds. The legitimate functions of unionism are quite sufficient to afford opportunity for as much energy and brains as are available. In the future the power vested in the officers will probably be much curtailed. The members have been powerless to resist their own paid officers in the downward rush to ruin.

Now that the victory is with employers they are being called on to live up to it. Many are anxious to do so, but the few ultra-conservative will need to stir themselves or be left behind. The possession of an old business is apt to hamper a man's views. Old tools are not removed as soon as they should be, and old systems are continued when out of date and when superior methods are known and elsewhere used. It is to this sort of thing, either forced on employers by unionism, or continued out of habit, that so much American machinery owes its position. Given a general revivification of establishments in England, and it is difficult to see how much of the German and American competition can continue. In comparing the prices of certain standard articles as made in Germany with the same things made in an English free-labor shop, the possibility of German competition is seen to be practically hopeless, and there is no doubt that in the better efficiency of labor and the abolition of restraints on management there is an enormous margin of profit for English trade, even where now only just able to hold its own. Recent experience with non-union men in the place of the strikers has shown it possible, with better wages to the men, to reduce the wage cost per item of production by one-half or a third, according to circumstances.

Reduction of labor costs does not mean reduced wages. This is a fact that trades unionism has refused to learn, to which it has shut its eyes, despite an ample sufficiency of proof, at home as well as abroad. The lesson has now to be learned, and it probably will be learned.

At the moment of writing, men are leaving the Amalgamated Society of Engineers in considerable numbers. One blacksmith informs me that he has been a member for fifteen years, but has left it disgusted that the strike ever took place. In fact, the London smiths have retired in large numbers and set up a new society of their own. Smiths are so essentially skilled men that they of all men have viewed with distaste the admission of all sorts into the ranks of the A. S. E.

Very possibly the eight-hour day will come about quietly and of itself, so to speak, as soon as the production of the country per man has again made it possible to compete with other countries. Men have been known to declare themselves weary with the effort of doing nothing and appearing busy. Grown men trying to make both ends meet and hampered with all the worries and details of business have had to receive deputations of beardless youths from headquarters of the A. S. E. to demand this thing and the other; to order that such and such a machine must not be worked at less than so much pay to the attendant; that certain work is being done by boilermakers which properly belongs to engineers, or that the engineers are doing too much work. In fact, the forms of interference have been legion, and people of all shades of opinion have seen the importance of the issues involved.

A hundred years ago machinery was broken up by an ignorant mob because they saw plainly that if a machine could do fifty times as much as an individual man there would be no work left for them to do. Now these machine wreckers have one's entire sympathy. It was so perfectly obvious that machinery would produce starvation, and workers were already near enough to it, that they would have been mad not to wreck the machines. They were ignorant; they had no precedent to guide them; there was not a long past of a hundred years to prove to them that the results of machinery are just the opposite of what they appear likely to be. Can we wonder they wrecked the machinery of a hundred years ago? But to-day the largest English trade society acts in exactly the same way, except that they do not break the machinery and do not riot. They set themselves quietly and obstinately to reduce the output of a new tool to less than half what a fifty-year-old tool will turn out. They will run a lathe for hours in the week with no cut on, all the time appearing busy, and in all this they might just as well wreck the machine. It would be more honest. They have no excuse for this latter-day exhibition of ignorance. The descendants of the machine wreckers of Lancashire have long enough learned the lesson of machinery, and are to-day the best paid set of people in the world, and all on piece rates. But the so-called skilled engineers have so little appreciation of history that they cannot see to-day that machinery always has improved the condition of labor and always has made more work. They seem entirely oblivious to the plainest teachings. Most people think, however, that the evil has cured itself, and that before funds again accumulate for a fight the wages of the men will become so much better under the improved methods now possible that no further strike on such foolish and erroneous ideas is likely to take place.

The daily press calls the folly Socialism. This is quite a misnomer. Socialism presupposes an absolute honesty of purpose on the part of everyone. Indeed, without honesty Socialism cannot exist, and one might almost say, with perfect honesty all round, there would be no need for the most ideal Socialism. It is not Socialism or any other particular force that has ruined the A. S. E., but simply a misguided attempt to stop the progress of the world so far as their art is concerned and to set aside and ignore the lessons of human experience.

London, England.

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A Russian friend, noticing our item to the effect that in the Russian language there is no term for duplex steam pump and that for this expression the word "worthington" is adopted, states that this is not correct, and he gives us the correct translation of "duplex steam pump." This we cannot print for lack of the necessary Russian type; but it is evident that the equivalent words exist in the Russian language. Our friend states that the usage in this regard in Russia is precisely the same as in other parts of the globe.

Losses Due to Eddy Currents in the Pole Pieces of Electric Machines.

BY WM. BAXTER, JR.

In an electric generator the current flows in the wire, not because the copper of which it is made possesses any properties that assist in concentrating the action in it, but simply because the wire affords a path in which the electric current can circulate with freedom. If there are any other parts of the machine within the space in which the inductive actions take place, in which electric circuits can be established, currents will flow in them, and the strength of these currents will depend upon the amount of resistance they encounter, and to the extent of the inductive action that brings them into existence. If the core of the armature were made in one piece, electric currents would be induced in it, because it is subject to the same inductive action as the wire itself. This is not a mere theoretical conclusion, but is a well demonstrated fact. When the electric light first came into use, the knowledge of electro-magnetic actions was not very extensive, and the fact that currents would be generated in a solid core was not generally understood. In consequence of this ignorance, solid core armatures were used in the majority of machines, with the result that a large amount of power was absorbed in useless currents. Besides the great amount of power required, the machines heated up to such an extent that the armatures were short-lived. All this trouble was caused by the fact that the cores of the armatures were made of cast iron, and large currents were generated in them. It soon became known that the temperature of the machine could be kept much lower by making the armature core of sheet iron in the form of rings or disks placed so as to be at right angles to the wire; and not only that the temperature could be reduced, but also that a large amount of power could be saved. When this improvement was made it was believed that perfection had been nearly reached, but in time it was found that the pole pieces heated up more than other parts of the machine, and a study of the theory as well as experiments showed that the cause was the same as that which gave so much trouble with the armatures. In the case of the armature the operation by which currents are generated in the core is so simple that it is easily traced out, but the action that generates currents in the pole pieces is somewhat more complicated. It can easily be explained by means of Fig. 1, which is a diagrammatic representation of an armature and the ends of the poles between which it revolves. The circle *A* represents the armature and *P P* the poles. The magnetism of the field, which is concentrated upon the armature by means of the pole pieces, acts in the direction of the line *B C* and tends to magnetize

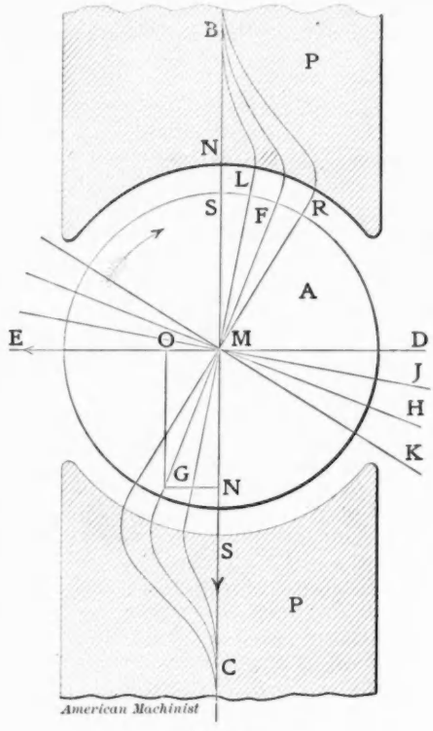


Fig. 1

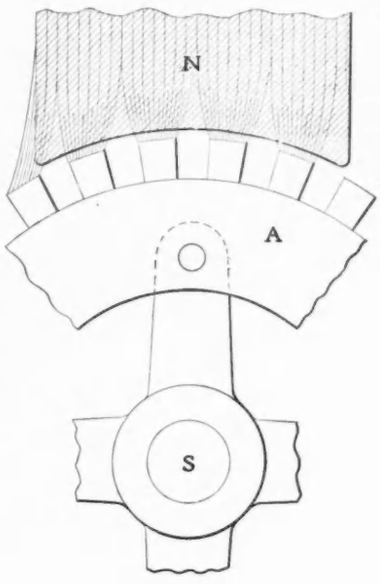


Fig. 2

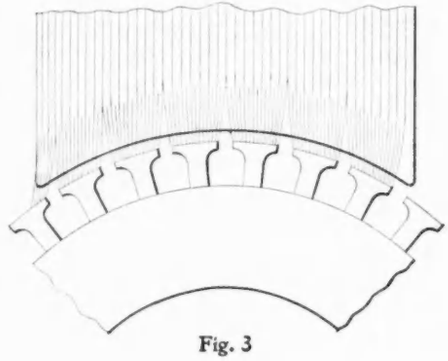
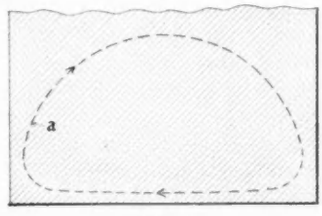


Fig. 3



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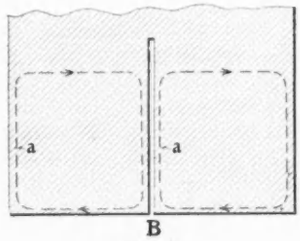

Fig. 5

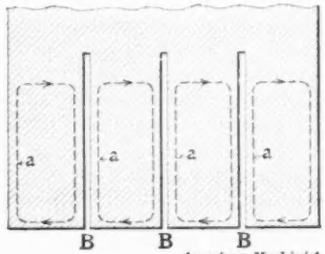

Fig. 6

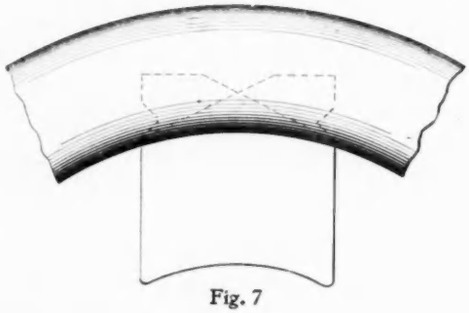

Fig. 7

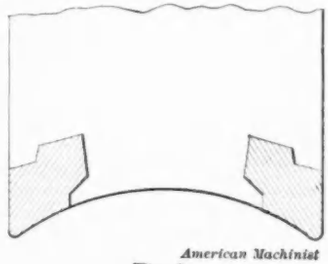

Fig. 8

THE CAUSES AND PREVENTION OF EDDY CURRENTS IN POLE PIECES.

the armature core with an *S* pole at the top and an end pole at the bottom. The wire wound upon the armature tends to magnetize the core with the poles on the sides on the line *D E*. As these two magnetizing forces act at right angles to each other, it follows that the real direction of the magnetic lines of force will not be in accordance with either one, but will be in a direction depending upon the relative magnitude of each force. According to the principle of parallelogram of forces, if a body were placed at *M* and were drawn to the left by a force equal to the line *O M*, and downward by a force equal to *M N*, it would move in the direction *M G*. What is true of mechanical forces is true of magnetic forces, and if the armature magnetism bore the same relation to that of the field as the line *M O* to the line *M N*, then the actual direction of the magnetic force acting on the armature would be along the line *G F*, and this line would also be the central line of the force. If the magnetism of the field acted alone, the central line would be *B C*, and the magnetism would be equally distributed over the entire face of the pole pieces, but when the center is shifted to the line *G F* the magnetism on the right is concentrated, and that on the left is weakened by being spread out over a greater width of pole surface.

The points at which the current enters the armature are always upon a line at right angles to the direction of the field magnetism, therefore when this is shifted from *B C* to *G F*, these points are advanced from line *D E* to line *H*. The current enters the armature through the commutator, which is so constructed that the points at which the current enters the wire are shifted backward as fast as the armature revolves, and therefore remain stationary in space, comparatively speaking. During the time the brushes are pressing upon the same set of commutator segments, the current enters the armature wire through the same points, and when the brushes pass off of one set of segments to those back of them, the points where the current enters the armature shift back through an angle equal to a commutator segment. The current then continues to flow into the armature wire through the same points until the brushes pass onto the next set of segments. From the foregoing it will be seen that if the angle covered by a commutator segment is equal to that between the lines *J* and *K*, that each time the brushes change from one set of segments to those back of them the points at which the current enters the armature will change from line *K* to line *J*, and as the armature revolves it will advance to *K* and then drop back again to *J*. In consequence of this shifting of the point where the current enters the armature wire, from line *J* to line *K* and back, the armature magnetism is constantly vibrating between these lines, and this causes the field magnetism to shift from line *L* to line *R*. This shifting of the field magnetism causes the density of the force over the surface of the poles to constantly vary, and this variation sets up an electromotive force, and if there is a complete circuit, an electric current

It is quite evident that the greater the angle between the line *L* and *R* through which the field is shifted, the greater the electro-motive force; therefore, to remedy the defect, the proper course to pursue is to reduce this angle. This can be accomplished in two ways; one is by increasing the number of commutator segments, and the other by weakening the armature magnetism so that the angle *D M H*, by which it shifts the field from its natural position, may be reduced.

If the armature core is smooth the foregoing action is the only one by which eddy currents can be generated in the pole pieces, but if it is grooved, another action will take place, and its effects will be greater than those of the one just explained. From Fig. 2 the nature of this action can be understood. In this figure *N* represents a pole and *A* a portion of a ring armature core of the grooved type. *S* is the shaft around which the armature rotates. As the distance between the ends of the teeth on the armature and the pole face is so much less than between this face and the bottom of the grooves, nearly all the lines of force will pass to the armature through the top of the teeth, and the result of this will be that there will be very little magnetism in the pole pieces opposite the grooves. As the armature rotates, the lines of force will hang to the tooth passing from under the end as long as possible, and will then jump back to the next tooth. As this tooth cannot carry all the lines of force of two teeth, some of the lines will be forced back to the second tooth, and some from this to the third tooth, and so on until the surplus is distributed. This action will take place each time a tooth passes from under the pole. As there is very little magnetism in the pole opposite the grooves and a great deal opposite the teeth, each time the lines swing back from one tooth to another, an electro-motive force will be developed in the pole pieces. The larger the teeth, the greater the effect; therefore, to reduce the action, the teeth should be reduced in size and increased in number. Another way to reduce the effect is by spreading out the ends of the teeth, as shown in Fig. 3. When this is done the width of the groove becomes small compared with the width of the tooth, and as a consequence the distribution of magnetism over the pole face is more nearly equal, and the nearer equal it is the less the inductive action.

The best way to avoid the difficulty is to construct the poles so that the eddy currents are confined to short paths of comparatively high resistance. Figs. 4, 5 and 6 illustrate the benefit derived from this procedure. These figures represent sections through pole pieces parallel with the armature shaft. Fig. 4 is a solid pole, Fig. 5 has one groove sawed through it, and Fig. 6 three grooves. The curves *a* indicate the path in which the eddy currents circulate. In Fig. 4 the path is large, and the part in which the electromotive force is set up is nearly one-half, being the straight part of curve *a* on the lower side next to the face of the pole. In Fig. 5 the two paths are smaller, and the part in which the electro-motive force is developed is little over one-quarter of the entire length of the curve. In Fig. 6 the paths are still smaller, and the part opposite the pole face is a smaller portion of the whole curve than in either of the other figures. The effect of this subdivision is that the electro-motive force in each path is reduced, and the resistance is relatively increased, and therefore the total amount of energy is reduced as the number of paths is increased.

Slotting the poles is sometimes resorted to, but when the best results are desired the pole is made of sheet iron, so as to greatly increase the subdivision. A common method of construction is to make the poles of sheets riveted together in the form of blocks and attach them to the casting, forming the field frame by means of bolts. Another way is to make the poles with the back end dove-tailed and cast the field frame around them, as shown in Fig. 7. In a design lately brought out the poles are made solid, and the sheet iron lamination is only used at the corners. This is not as good an arrangement as that of having the whole pole laminated, but as the greater part of the eddy currents is generated at the corners, the difference practically is not very great.

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The "American Machinist" has very few "authorized" or "regular" correspondents. No introduction nor preliminaries of any kind are necessary in order to become a contributor; nor ought anyone to wait for a personal invitation to contribute. We are always glad to hear from anyone and from anywhere on subjects pertaining to shop practice and machine construction.

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One of the advantages of electric traction on suburban lines now being discussed by railroad and electrical engineers is the greater speed to be expected from the quicker starting of the trains. Mr. Lundie, of the Illinois Central Railroad, has mapped out a schedule for the contemplated electrical equipment of the suburban lines of that company, which involves an acceleration up to 40 miles per hour in twenty seconds.

That Practical Problem.

As a practical solution of the "Practical Problem" sent in by a correspondent some time ago, asking for a method of stamping figures upon the edges of cast-iron disks, the following device has been brought to our notice by Mr. Robert J. Hearne, secretary and treasurer of the Dubrow & Hearne Manufacturing Company, 12 Wooster street, New York. This is especially interesting from the fact that it has been actually made and is in satisfactory use for the purpose proposed, being employed for stamping the disks of a counting device made by the firm referred to.

The arrangement is used upon a common punch press, and will be readily understood by reference to the sketch. *B* is a special casting, to be fastened to the bed of the punch. It is bored for the shaft *Y* and also for the head or turret *A*. This head *A*, which is a solid casting, is shrunk upon the shaft *Y*, and the ratchet wheel *O* is pinned on the outer or left-hand end, which secures the shaft in the standard or frame *B*. *C* is the disk to be stamped. It slips easily into a central excavation in the head *A*, and is held in place by the thumb-screw *J*, which is tapped into the removable cross-strap *D*. The disk has a projection *N*, and two pins *M* are used in connection with this to locate the disk correctly in the turret. The ten ratchet teeth which appear in the sketch are also a part of the disk *C*. The turret is drilled with ten radial holes for the punches, only one of which is shown where the turret is cut away in Fig. 2. These holes are drilled 5-16 of an inch and counterbored 7-16 of an inch to a considerable depth. The punch, the inner end of which is cut and hardened for making the required impression on the disk, is enlarged at *E*, the spring *Z* constantly forcing it outward and the thimble *I* holding it in. The part at *E* is flatted, and the flat end of screw *G* holds the punch from turning, while the screw *H* holds the thimble *I* in place. The outer end of the punch thus normally projects beyond the periphery of the turret, while the inner end clears the disk. A circular groove *K* is cut in the frame *B* to clear the ends of the punches.

This device being properly set in the press, the slide comes down upon the end of the punch and makes the required impression. Then upon the return of the slide the hooked pawl *P* catches in a tooth of the ratchet wheel *O* and moves it a tenth of a revolution, or 36 degrees, when the slide comes down on the next punch, and so on all the way around. *F* is a brake which stops the turret from turning too far, although no minute precision is required for its turning. A pull spring, not shown, is attached to pin *R* to hold the pawl in contact with the ratchet.

This arrangement, as was said, is doing its work quite satisfactorily. It is, perhaps, in most of its parts, made heavier than was required, but in this place this is no fault. The punch in which it is used makes about 100 strokes per minute, and the ten required strokes being made without a stop, the disks are punched quite rapidly. This firm tried rolling or milling devices for this purpose without success.

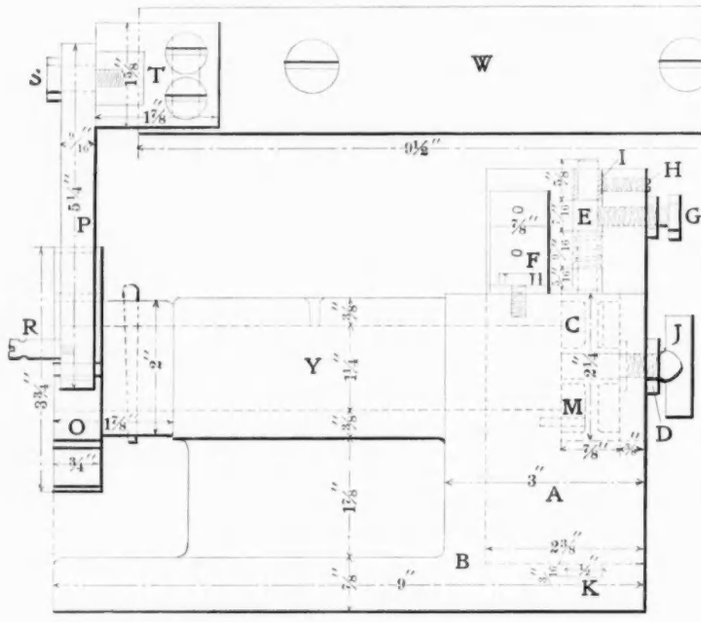

Fig. 1

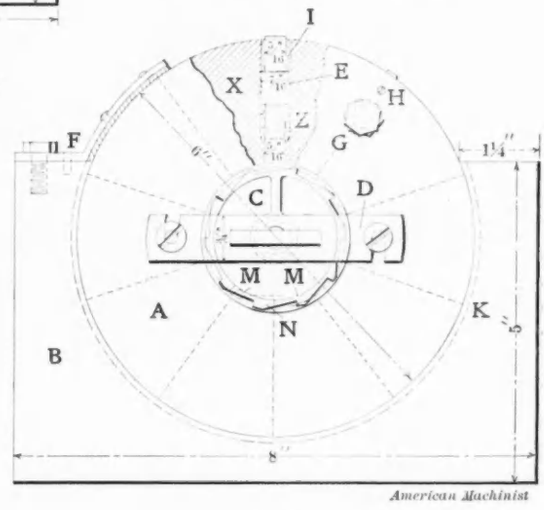

Fig. 2

DEVICE FOR FIGURING REGISTER WHEELS.

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Letters from Practical Men.

Tool-Post for Bench Lathe.

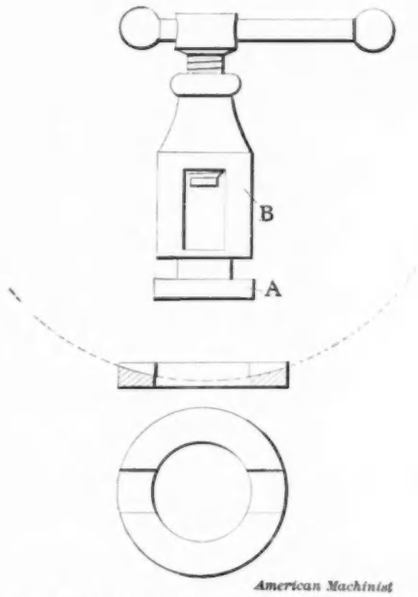
Editor American Machinist:

The letter of "Machinist" in your issue of February 24 interested me somewhat, as I often wondered if the inventor of that detached pin for a tool-post screw held a grudge against machinists in general, or whether he simply didn't know any better. However, "Machinist" wasn't as badly off as he might have been, as there is a lathe on the market that is very much admired by the Teutonic instrument makers that hasn't any pin at all; the maker only supplies the hole, leaving the workman to use the tang of a file or "any old thing" that comes handy (or unhandy). But my bench lathe has a pin supplied by the makers, and it can't very well get lost, either, unless the screw gets lost also. In fact, it is a loose pin with a knob riveted on each end. I can anticipate the objection that may be raised against this device—that the pin might come in the way of something—but it can always be pushed over to the other side, and it isn't at all likely that it is going to interfere with something on both sides of the tool-post at once. I have used this identical tool-post for about ten years, doing about all the different kinds of jobs that usually fall to a bench lathe, and many that ought to be done on other tools, and I do not recall a single instance where I would have been any better off had the pin been capable of coming out.

"Machinist" certainly improved on the original state of things, but I don't think it is quite as handy as it might be, as his pin has to be inserted right side up every

time, and it takes two motions to get it in place and locked before he is ready to do any twisting.

If "Machinist's" drawings are correct I do not think all the iniquity lies in the pin as orginally made. The bottom of his tool-post seems to be of the same size as the body, so that the washer drops off as soon as the tool-post is taken from its T slot. My tool-post is a little larger at *A* than at *B*, which prevents the washer



TOOL POST AND WASHER FOR BENCH LATHE.

from getting away from its sphere of usefulness. The wickedness even extends to the washer itself, which, as he shows it, seems to be one of those saucer-shaped affairs that have a well-developed faculty for catching and holding chips. The washer shown herewith I consider a much better style, as the concave part does not extend all the way around; but it has a seat for the shoe sunk in with a milling cutter of the same thickness as the shoe, and the same radius of curvature.

If "Machinist" wants to do a favor for a long-suffering public (which includes myself) let him devise some way to prevent the shoe from dropping out when the tool-post is not in its T slot, and yet give it freedom of motion throughout its legitimate range.

WALTER GRIBBEN.

Brooklyn, N. Y.

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Rigs for Electric Repairs.—Key-Seating Tool.—Lathe Tool Holder.

Editor American Machinist:

As the lecturer says, the first thing this evening, ladies and gentlemen, we will show a horse, Fig. 1. This one is a beauty, tail up, head down, in which position solder will not run back of the commutator.

Fig. 2 is a consolidation of scrap iron, I beam and a couple of gears, beautifully blended into a charming outfit for banding armatures, winding fields, etc.; the

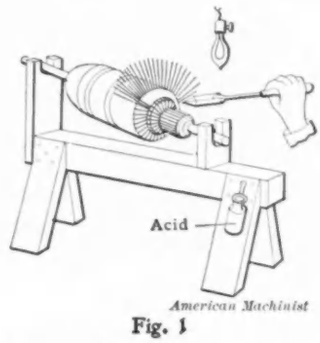

Fig. 1

SOLDERING A COMMUTATOR.

gears are interchangeable and the cranker can get any speed he desires.

Fig. 3 shows a structure on the mile-post plan, a handy thing for winding converter coils. The three fan-like wheels above the winding form are each sup-

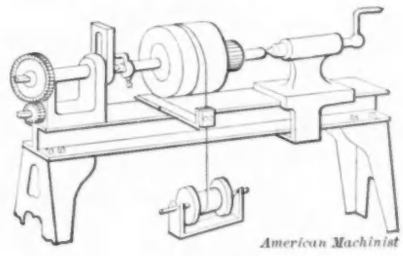

Fig. 2

HOME-MADE WINDING RIG.

plied with tin arms designed to tally the turns; an electric bell goes with it, but is not shown; the object to the right the operator will find use for for without further description.

Fig. 4 belongs to the machine shop. Any misguided machinist within my hearing who has meandered around the

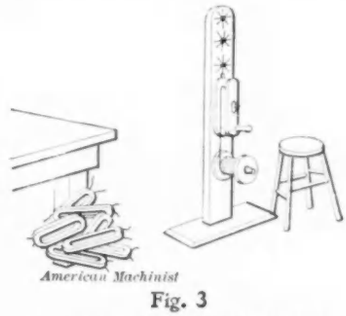

Fig. 3

WINDING CONVERTER COILS.

shop from time immemorial with a vacant stare in search of that goose-neck tool which was about the right length to go through that hub will appreciate the grandeur of this simple solution.

Lastly, in Fig. 5, we allude to another version of the lathe-tool holder problem. You and I, Mr. Editor, have seen the rise and fall of this handy tool-holder problem for at least fifteen years, and there never was a harder thing to get your old "jour" to use than one of these pretty tools. There are lots of them on the market, good and cheap, and they save time and money, yet plead for them with tears in your eyes, your royal machinist is going to loaf just so much in

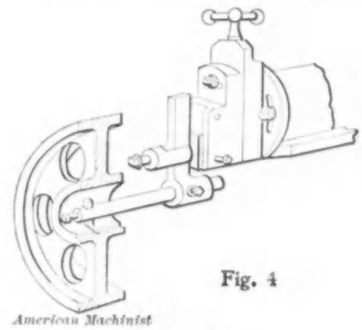

Fig. 4

KEY-SEATING TOOL.

the blacksmith shop, and there is going to be that same old consultation about that cutting-off tool and that diamond point forever. The tool I show comes nearer in effect to the old diamond point than any I have ever seen or used, and the more you compare the position of the cutters the more you will see there isn't

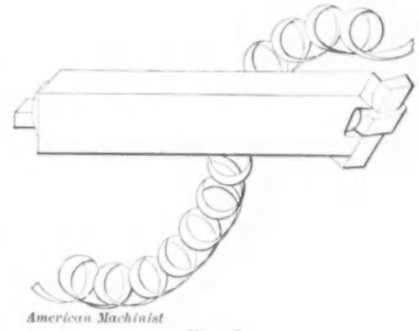

Fig. 5

A TOOL HOLDER.

anything like it on the market. I ought to get it patented, but in view of the above observations I calmly desist.

L. C. SHARP.

Omaha, Neb.

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Dividends Paid by German Machine Building Companies.

Editor American Machinist:

In the letter of Mr. Charles Davis, printed in one of your January numbers, this gentleman stated that Americans were congratulating each other on dividends of 12 and 15 per cent., while many of the large German manufacturing companies were paying all the way from 25 to 40 per cent. each year.

As Mr. Davis is reporting in his statement exclusively about matter in connection with the manufacturing of ma-

chinery, of course, anyone reading the letter will believe many German machine works would earn from 25 to 40 per cent. a year.

Allow me to show you that this is not the case, and Mr. Davis seems to have been told wrong or to have put down his statement under a wrong impression.

As you will find in the accompanying exchange list of the Berlin *Exchange*, there was in 1896 only a single machine works out of about forty works altogether that paid 40 per cent. All of them that are known to us being machine concerns are pointed out with red ink; the other concerns are breweries and other industrial societies in the list.

The other machine works are paying a dividend of

24	per	cent.,	1	society
22½	"	"	1	"
20	"	"	3	"
18	"	"	1	"
16	"	"	1	"
15	"	"	1	"
14	"	"	4	"
13	"	"	1	"
12½	"	"	1	"
12	"	"	2	"
10	"	"	3	"
8½	"	"	1	"
8	"	"	4	"
7½	"	"	1	"
7	"	"	3	"
6	"	"	3	"
5½	"	"	1	"
5	"	"	2	"
4	"	"	1	"
2	"	"	2	"
1½	"	"	2	"

In the year of 1897 we have among 23 societies of the same list—

With 20	per	cent.,	1	machine	society
" 16	"	"	2	"	"
" 15	"	"	2	"	"
" 14	"	"	1	"	"
" 12½	"	"	1	"	"
" 12	"	"	2	"	"
" 11	"	"	1	"	"
" 10½	"	"	1	"	"
" 10	"	"	5	"	"
" 9	"	"	1	"	"
" 8	"	"	2	"	"
" 6	"	"	2	"	"
" 2	"	"	2	"	"

Werkzeugmaschinenfabrik "Union,"
EMIL DIEHL,
OSCAR UFERT.

Chemnitz, Germany.

[Mr. Davis, to whom proof of the above was sent, states that he had in mind German manufacturing companies generally and those making machinery only.—ED.]

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Holding Work on the Planer.

Editor American Machinist:

Mr. Robert Grimshaw, in the "American Machinist" some time ago, spoke of a device for holding work upon a planer bed. In our shop we have used a similar arrangement (but much simpler) for several years, and I think it is superior to the one he saw across the "pond." It contains but one screw, which is put in at a slight angle with the bed of the planer. It does not have a heel to rest on the top of the bed, but rests against the slot, as at *a*, Fig. 1. It is about ¾ of an inch wide, so that when the piece to be planed measures over 4 inches in length, two or more of them may be used and placed at any desirable distance apart. Pieces of flat iron about ¼ of an inch thick are interposed between the screw and the work. They are made as shown in Fig. 2, with a heel at *b*, the idea being that when the screw advances it causes the intermediate piece to swing upon the heel which acts as a fulcrum, the edge *c* lowering and forcing the work down upon the bed of the planer, the lines of movement taking the directions shown in Fig. 1, the heel remaining almost stationary.

A strip of flat iron *d*, Fig. 1, is held by a bolt or two, *f*, to the side of the bed, projecting about ⅛ of an inch above it, so that the work is held as low as possible, this being essential when the sides of the piece to be planed are slightly undercut. In this case, if it stood much more than ⅛ of an inch above the bed, the work would rise while being fastened.

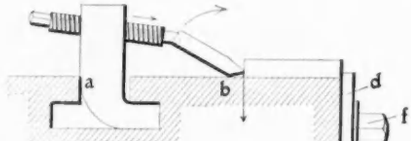


Fig. 1

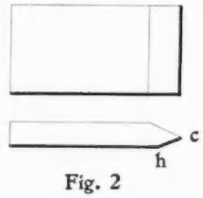


Fig. 2

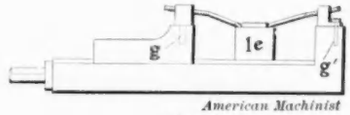


Fig. 3

HOLDING WORK ON THE PLANER.

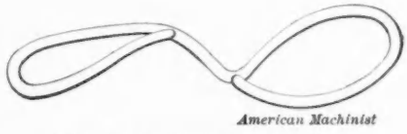
I have applied this thrust block to the shaper chuck by making the thrust blocks to fit into the receptacles for the chuck centers, as at *g* and *g'* in Fig. 3. Plates or strips which are very thin may be very conveniently planed by having a thrust block on each jaw and placing the work upon parallel blocks *e*, and making the intermediate pieces thin at the edge where they engage with the work.

EDWARD J. KUNZE.

Shop Eye-Doctor's Tools.

Editor American Machinist:

Referring to the article in issue of February 3, under the heading above, I wish to say, not in its defense, however, that the "frazzled pine stick" spoken of seems to be all that some men will allow to be put against their eye by a shopmate. If the toothpick won't fetch it they must go to a doctor. For my own part I greatly prefer a good steel tool made for the purpose, and in the hand of a fellow workman who has had some practice at such work, than to have my eye punctured with the aforesaid pine stick. Nearly every shop, where many men are employed, has one or more who are very good at this work, and in some cases quite respectable kits are found.



FOR HOLDING THE EYEBALL

The tools spoken of in the article and furnished by Mr. Barrett are all right so far as they go. I would also add the glass and the implement for holding the eyelid open, as shown by the perspective sketch. It is very simple, and anyone can make one in a few minutes. It is made of wire ⅛ of an inch to 5-32 of an inch in diameter, and the part fitting over the eye is about 1 inch small diameter by 1¼ inch large diameter on inside It will further be noticed that it has an offset between the globe and the handle of about 1 inch, so that as the operator holds it in his left hand, wishing to operate on the left eye, it will bridge over the nose and fit as nicely on that eye as on the other.

In making it a nicer job is done if the ends are soldered where they touch the wire when bent around, though it is not at all necessary.

EDWARD DE HART.

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Senator Nelson has introduced an amendment to the Post Office Department Appropriation bill, and among the items included is $60,000 for the purchase or rental of cancellation machines.

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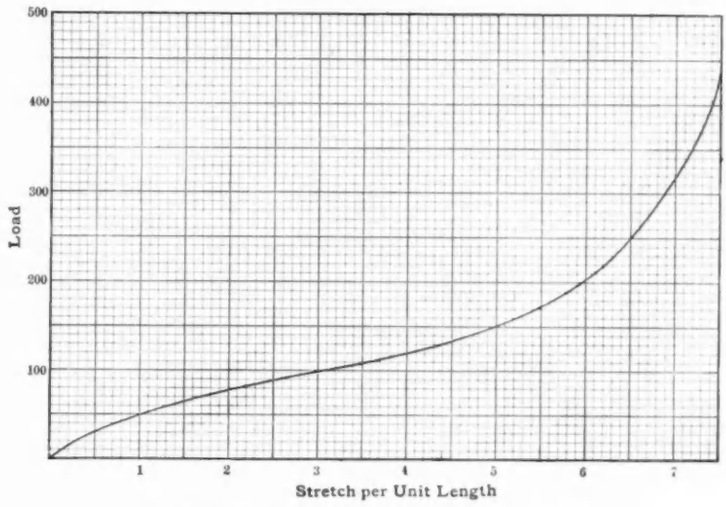
The motors for the equipment of the Brooklyn Elevated Railway will be the Walker 15 L. 80 horse-power type. The Brooklyn road is the first elevated railway in the East to adopt electric traction, although it is thought by many to be a matter of but a few months before all the elevated railways in Greater New York will change their motive power from steam to electricity.

Singular Stress-Strain Relations of India Rubber.

BY R. H. THURSTON.

The curious and unaccountable behavior of india rubber in thermodynamic transformation of energy under load has long been familiar; it is, perhaps, even more generally known that it exhibits a peculiar relation of elongation to load when approaching its limit of tenacity, but I am not aware that this later phenomenon has ever been exhibited by formal test or by graphic representation of the results of such tests. It is a matter of common observation that, when this substance is subjected to a pull of steadily increasing intensity, its resistance increases, as does that of any elastic and ductile material; but that, at the end, instead of suddenly losing power of resistance, or even snapping without observable decrease of load, its resistance for a time rapidly and largely increases up to the point of rupture. This can be readily felt in even the breaking of one of the small bands of partially vulcanized rubber now so universally employed for filing papers and other purposes. At the end of the period of extension the resistance rises so rapidly as to produce the sensation of bringing the hand up against a rigid obstacle, resisting further elongation.



STRESS-STRAIN DIAGRAM OF INDIA RUBBER.

Fig. 1 is the stress-strain diagram of a strip of rubber, partially vulcanized, but not sufficiently to disguise the peculiar characteristics of the material.

Studying this diagram, it will be observed that the substance behaves precisely like other familiar materials, up to a point which, in this case, is found at a load of 30 per cent. of the maximum, the breaking load, and at an extension one-half the maximum. At this point there exists a reversal of the line, and the curvature is thence maintained convex to the axis of X, up to the point of rupture; fracture taking place, at the end, sharply and without any indication of that method of flow of the mass which, in the case of the irons and softer steels, for example, permits a falling off of resistance after passing a point of maximum tenacity well within the breaking limit. The ratio of increase of load to increase of elongation steadily increases from the zero point, as with all substances, other than iron and steel, so far as known, up to this point of contrary flexure on the diagram, at which place the ratio is inverted and resistance increases in greater proportion than extension, finally assuming a comparatively high value.

The singularity of this action will be brought into relief by examining the diagrams produced with other materials employed in the arts.

* * * India rubber exhibits none of the phenomena giving the characteristic form of the diagrams of the irons and steels. Even when stretched to the point of rupture it restores itself very nearly to its original dimensions, and gradually recovers a part of the loss of form at that instant observable. Its almost complete stability of form when relieved from load, and especially when in the shape of springs such as are used on railway trucks, constitutes one of its most valuable properties. Like cork, when confined laterally it is practically indestructible and incapable of distortion when used as a spring. The singular stress-strain relation of the substance may probably be found to give it peculiar value for many other purposes. The sample illustrated by our diagram was of the kind employed for springs and rubber bands, and, as usual, slightly vulcanized. * * * So far as known, no other substance gives such unique relations of forces holding the substances in stable form to the variations of form to which the external application of force gives rise. The volume of the mass remains, so far as can be seen, constant, or nearly so, and the expenditure of work upon the substance results simply in changing the intermolecular distances of adjacent particles. This fact will probably be found to simplify the process of experimental interpretation of this curious case.—Abridged from "Science."

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Technical Publications.

THE MECHANICAL WORLD. Pocket Diary and Hand Book for 1898.

This is the eleventh annual issue of a book which, though sold at 6d., contains very much valuable matter for engineers and mechanics, including useful formulas, tables, etc. 260 4x6 inch pages, cloth. "Mechanical World," New Bridge street, Manchester, England.

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A catalog of the "Scientific American Supplement" has been received from the publishers, Munn & Co., of this city. This catalog is arranged in the form of an index, and by its means any article which has been published in the "Supplement" during the twenty-two years of its existence may be readily located, and we are informed that all the numbers can still be supplied. The catalog is substantially and neatly bound, and is sent free to any address on application to Munn & Co., 361 Broadway, New York.

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We have received from the Cahall Boiler Company a finely illustrated pamphlet of 27 9x12 inch pages, reprinted from the "Electrical Engineer," and giving a very full description of the plants of the Edison Electric Illuminating Company, of Brooklyn. To those who do not have a realizing sense of the gigantic proportions to which electric central stations have grown this pamphlet will give a better idea of those proportions, as well as of the intricate and elaborate machinery comprising their equipment, than anything else we have seen.

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THE STANDARD ELECTRICAL DICTIONARY. By T. O'Conor Sloan. 632 5x7 inch pages and 392 illustrations. Second edition, Revised and Enlarged. Norman W. Henley & Co.

This edition of a well-known and standard work has been brought up to date by the addition of an appendix of fifty pages, covering all accepted terms which have come into use since the issue of the original edition. No better illustration of the magnitude of electrical development could be cited than that given by this book. It is, however, more than a mere dictionary, being a work of reference of far wider use than the mere definition of terms.

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The British Strike and Lockout.

So long as the engineers' strike and lockout was going on in Great Britain we declined to publish some proffered articles about it on the ground that our space could be better employed in the presentation of strictly mechanical matter. At the same time we asked our correspondent, W. H. Booth, whose fair-mindedness in such matters will hardly be doubted by those who have been in the habit of reading his contributions to our columns, to give us his views of the general results of the contest when it should be fairly finished and the air sufficiently cleared to permit reliable observations to be taken. Particularly he was asked to give his opinion as to the probable effect of the contest upon the ability of British engineering workshops to meet foreign competition, especially American. Mr. Booth's article, written in answer to this invitation, appears on another page of this issue. It is manifestly not written in a spirit of antagonism to trades unions as such, but in the firm conviction that in this instance the union was fighting to maintain a principle which no power could possibly maintain because opposed to economic principles. The article is well worth reading by those who wish to know something of the struggle that is now over and of the lessons that may be drawn from it. It should be not merely read, but thought over until the real significance of the facts stated is perceived.

A technical journal such as ours can touch only the surface of such matters after all. Study of the deeper, underlying causes of the belief that there is a limited amount of work to be done, and that the men who, by special training, have set themselves aside for the purpose of doing that limited amount of work in their own occupation are justified in resisting any encroachments by outsiders, belongs to the science of political economy; but the closet political economists—those who have learned all they know of political economy in colleges and who now teach it by classroom lectures and by books—will never solve the question.

Switzerland has probably come much nearer a solution of these questions than any other country. Americans should not flatter themselves that our relative freedom from such problems is the result of superior intelligence. It is more the result of superior environment—absence of conditions which always develop with the passing of a country from what is called "a new country" to an old one. Switzerland, regarding which as an industrial country, we shall have more to say in a near-by issue, is almost entirely free of labor difficulties. Referring to that country and to what the Swiss people have accomplished, J. W. Sullivan, in his book "Direct Legislation," says: "They have simplified the structure of government, held their officials as servants, rendered bureaucracy impossible, converted their representatives into simple committeemen, and shown the parliamentary system not essential to law making. They have written their laws in language so plain that a layman may be judge of the highest court. They have forestalled monopolies, improved and reduced taxation, avoided incurring heavy public debts, and made a better distribution of their land than any other European country. They have practically given home rule in public affairs to every community. They have calmed disturbing political elements—the press is purified, the politician disarmed, the civil service well regulated."

When England and America have done as much labor difficulties will not be very serious, for the natural advantages of both countries are superior to those of Switzerland.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(22) W. H. R. asks: Would you please inform me how I can securely fasten, so it will stand hard work, soft sheet rubber about ½ an inch thick, to wooden rolls which are from 4 to 6 inches in diameter? A.—A cement made as follows will fasten rubber to wood, and make it impervious to the action of gases or fluids: Soak pulverized gum shellac in ten times its weight of strong ammonia. Rubber cements for this purpose can be obtained at almost any rubber store, and it is probable that some of the tire cement used by wheelmen will answer.

(23) C. P. B. writes: Will you inform me of the formula for making waterproof glue for holding walrus leather or felt to a wooden polishing wheel? By the use of common glue the water, in washing off a wheel, gets between the wheel and the covering, blistering the latter so that it is necessary to true the wheel up before covering with emery, which shortens its life more than all the work it has to do. A.—You might try the following: Mix a handful of quicklime with 4 ounces of linseed oil; thoroughly lixiviate the mixture. Boil until quite thick and spread on tin plates. It will become very hard, but can be dissolved over a fire like common glue. Glue may be rendered insoluble by tannic acid dissolved in a small quantity of soft water.

(24) Cameron, Cincinnati, writes: I notice in your issue of February 10 an article about a squaring-up gage, and my attention was called, by a very nice lady school teacher, to the fact that you had spelled the word g-a-g-e. She seemed to think it should have been spelled g-a-u-g-e, so then we looked at the other pages of the paper and found it spelled gauge in two or three different places, and then we consulted Webster's dictionary and found that both words meant about the same thing, only that gauge was the original and that gage was derived from it. I could not see why the "American Machinist," that is always trying to bring things to a standard, should use two different words to represent the same thing. Will you explain this for me? A.—We do not find in the reading columns of the issue you mention the word spelled in any other way than g-a-g-e; it is spelled in the advertising columns, however, g-a-u-g-e. You will find, if you consult the Century dictionary, very clear authority for the spelling without the u, and we have adopted that spelling in our editorial columns because we believe it is correct and preferable on account of its being shorter, if for no other reason. We do not, however, control the advertising department, and to some extent it is outside the pale of our enlightening and progressive influence.

(25) J. E. A., Chicago, Ill., evidently took a day off recently and sat down to ask us some questions with the following result. 1. If I wish to make a tap measuring 2 inches along the thread after hardening, what length must I make it before hardening and what pitch shall I use on the lathe to produce a thread 18 to the inch after hardening, and what kind of steel do you refer to in your reply to this question? 2. Please give the

percentage of expansion by hardening of the various kinds of steel for lathe and press and other tools. 3. How many times can the same piece of steel be hardened and still expand after each hardening? 4. Please give the percentage of expansion and contraction and effect of each successive heating for the different kinds of iron—wrought, cast iron, machine steel, etc.? 5. Is it not a mistake for books on the machinist's trade to claim that a U. S. standard thread should be equal in depth and pitch? Is the depth not about 48-55 of the pitch of a 60° thread? 6. What are the objects of a double and triple thread? 7. I have a book which informs the reader that an inch equals 254-100 of a centimeter, and on the same page states that a centimeter is larger than an inch. Is not this a mistake? 8. Please give the object of machine screws being numbered so much different from the drills which are used for them, also taps? 9. In your issue of December 23, 1897, you describe a rack cutter, and I do not understand from the description what revolves this cutter to make it cut different teeth at each stroke. 10. Is it not practicable to do the polishing operations by machine which are now done by hand? If not, why not? Our correspondent adds that "seeing your offer to answer questions, I decided to ask a few important ones which I have never found answered in books or papers. I could ask hundreds of others just as important and also unanswered, but I suppose you consider these enough for the present. A.—We do, in fact, consider these about enough for one instalment, and in fact some of the questions cannot be answered. The best answer in regard to the change in length and pitch in a tap as a result of hardening is to be found in our issue of February 3, where this subject is taken up and a device mentioned for producing a tap of the required pitch. As to the second, third and fourth questions, these matters have never been formulated so far as we know, and the behavior of a piece of steel or iron when heated and cooled by water cannot be certainly known in advance. It is by no means certain that every piece of steel will expand when heated and cooled, and in fact it is known that in some cases they contract instead of expanding. We were not aware that any book claimed that a U. S. standard thread should be equal in depth and pitch, but we know, however, that there are some books claiming to instruct mechanics which are liable to make almost any kind of wild statements. Your questions seem to mix U. S. standard with V threads; the two are entirely different, as you probably know. A 60-degree V thread is in section an equilateral triangle, with its base equal to the other two sides; its depth is .866 of its base or of the pitch of the thread, and this cannot be reduced to any equivalent common fraction which will be sufficiently accurate and at the same time convenient for use. It is best for a machinist who possesses a micrometer caliper to base his measurements on the fraction as above given. A U. S. standard thread is the same angle, *i. e.*, 60 degrees, but its total hight is reduced by a flatting at the top and bottom to three-quarters of a corresponding V thread, and is consequently .652 of the pitch. Double and triple threads are used for the purpose of getting a greater angle of helix or a greater advance of the nut or screw per revolution than would be possible with single-threaded screws cut to the same depth or with the same size of thread upon them. It is true that an inch is 254-100 of a centimeter, but it is, of course, not true that a centimeter is larger than an inch. The confusion you encounter regarding the numbering of drills and machine screws and taps may arise from the variety of gages used; that is, the screws may be made to one wire gage and the drills made to another, but if both screws and drills are made to the same gage it is evident that their numbers could not be the same, because a tap drill is always smaller than a tap and a clearance drill must be somewhat larger than a screw. The rack tooth cutter you refer to is rotated by the partially formed teeth of the rack itself owing to the fact that the feed takes place during the return stroke. This was explained in the article to which you refer. It is probably practicable to do by machine a great deal of the polishing now done by hand, and in fact the polishing machine is constantly encroaching upon or invading the field of the hand polisher. Each individual case must, of course, be decided by the circumstances surrounding it, and this is where the skill of the mechanic or of the manager comes in.

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Personal.

Passed Assistant Engineer W. S. Smith, U. S. N., has been detached from Newport News and ordered to the "Columbia."

Passed Assistant Engineer W. H. McGrann, U. S. N., has been detached from the Bath Iron Works and ordered to the "Columbia."

Passed Assistant Engineer L. M. Nulton, U. S. N., has been detached from the Naval Academy and ordered to the "Minneapolis."

Passed Engineer F. A. Hessler, U. S. N., has been detached from the "Baltimore" and ordered home. He has leave for two months.

Chief Engineer W. H. Harris, U. S. N., has been ordered to the Bath Iron Works; his unexpired leave of absence has been revoked.

Passed Assistant Engineer A. Moritz, U. S. N., has been detached from the New York Navy Yard and ordered to the "Minneapolis."

Kindly oblige us by sending in personal items regarding changes of foremen, superintendents and others prominently connected with the machine business.

Mr. A. A. Cary has resigned his position with the Abendroth & Root Company, to take effect April 1, and will be interested in a company which has a new speed controller and automatic stop for steam engines.

Mr. C. A. Clarke, of Hill, Clarke & Co., plans to visit Europe this spring, and sailed from New York on the 16th. He will visit several places in England and the large cities and most important business points on the Continent.

Mr. C. R. Richards has resigned his position with the Pratt Institute, of Brooklyn, to assume charge of the work in manual training connected with the Department of Mechanical Engineering of Columbia University.

Mr. Walter S. Ashton, formerly chief engineer for the Stifel Brewing Company, St. Louis, has been appointed general manager of the East St. Louis Ice & Cold Storage Company.

F. A. Scheffler has resigned his position as New York representative of the Stirling Boiler Company, and is now general factory manager of the Sprague Electric Company, at Watsessing, N. J.

Mr. Hugh R. McGregor, late superintendent of the works of the Sprague Electric Elevator Works, at Watsessing, N. J., is now a traveling representative of the Brown & Sharpe Manufacturing Company.

Mr. John Russell, formerly assistant foreman in the tool-room of the National Cash Register factory, of Dayton, Ohio, has resigned his position to take charge of the manufacturing department of the Foos Gas Engine Works, of Springfield, Ohio.

F. A. Pratt has retired from the presidency of the Pratt & Whitney Company, of Hartford, and is succeeded by Amos Whitney, Mr. Pratt being retained as director and consulting engineer. It is said that the change is made at the dictation of the New York syndicate which holds a controlling interest in the company.

W. H. Pike and J. T. Langhorne, of St. Louis, sailed on the 9th inst. on the "Teutonic" for Liverpool, and will go to Nottingham, England, the former as superintendent and the latter as manager of the Burroughs Registering & Accounting Company, which will manufacture there the machine known here as the Arithmometer. A complete plant of machinery and tools has been made here for the English factory.

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Obituary.

John Gleason, proprietor of a machine shop in Philadelphia, died in that city on March 11 in his seventy-sixth year. Mr. Gleason was born in Ireland, his parents coming to Taunton, Mass., when he was three years old. He learned his trade in the locomotive works of that city, and, it is said, ran the Gov. Paine, the first Baldwin locomotive on the Vermont Central Railroad. He settled in Philadelphia in 1857, invented the first balanced slide valve for locomotives, and a lathe for turning gun stocks, spokes and irregular forms. He started a shop in 1860, which had a healthy and long continued growth.

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We will send a box containing ten drawing board tacks to any draftsman who will send his address to this office.

Commercial Review.

NEW YORK, Saturday Evening, March 12, 1898.

THE ENGINE MARKET.

The tone assumed by sellers of engines and boilers at the present hour is marked by a little conservatism. Although there are some bright and notable exceptions, many concerns find it a little quieter than it was at about the end of 1897. Still there is big work constantly going on, and we cannot suppose that the current of the market has been seriously checked. Beneath the surface conditions may be improving all the time. There hardly ever is a time when a great many people do not talk despondently about market conditions, and the deduction of generalities from the ideas of all is such an inexact science that we are not willing to swear that the market is not improving at this moment.

Some diversity of opinion exists as to the effect that the crisis with Spain is having upon business. Quite a number of sellers are ready to admit that a quietness in orders during the last few weeks is owing to that cause. One gentleman with whom we have conversed wishes to know whether the prevalent feeling among others is not that the hour is at hand when they are willing to sacrifice their business for the good of the nation. But, generally speaking, engine people don't seem to be much excited over the war question from a commercial point of view, and many scout the idea that it has had any notable effect upon trade. That it does cause some disposition on the part of buyers to wait a few days or

Continued on page 37.

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Business Specials.

Gear wheels, gear cutting. Grant; see page 18.

Power hammers, Jenkins & Lingle, Bellefonte, Pa.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Conn.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Wanted—One machine shop in every county to manufacture my Patent Balance Slide Valve. Geo. Wolf, 215 Birch street, Cleveland, Ohio.

Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted

Experienced mech. draftsman. Box 145, AM. MACH.

Mechanical draftsman wants position; 9 years' experience. Address Box 115, AMERICAN MACHINIST.

Draftsman and machinist, exp. in general machine works, wants situation. Box 113, AM. MACHINIST.

Mechanical draftsman, tech. grad., 6 yrs' exp. gen. and elect. mach. desires per. pos. Box 144, AM. MACH.

Position as foreman machinist; 20 yrs.' exp., 8 yrs. foreman; reference. Box 121, AMERICAN MACHINIST.

Wanted position foreman millwright or patternmaker; good exp. and ref. Box 147, AMERICAN MACH.

A good mech. draftsman wishes position. Address G. W., care of A. Warth, No. 40 Second St., N. Y. City.

Wanted situation by blacksmith, good forger steel or iron; also wagon work. Box 141, AMERICAN MACHINIST.

Graduate M. E., some shop experience, four years' superintendent light manufacturing plant, desires position. Box 118, AMERICAN MACHINIST.

A shop superintendent of one of the most successful turret lathe builders desires a change; nine years' in present position; best ref. Box 130, AM. MACHINIST.

Draftsman with 7 years' experience as erecting engineer, draftsman, and in charge of electrical power plant wants position Address D, Box 91, Hartford, Ct.

Brass foundry foreman wants situation; understands all details in running shop, mixing metals from old and new stock, and a good manager of help; first-class references. Box 143, AMERICAN MACHINIST.

Wanted, by tech. graduate, with a first-class practical experience, position as instructor in manual training or mechanic arts; can teach physics, mechanics, machine design, etc. Elmwood, AMERICAN MACHINIST.

Draftsman, 27, with technical education, 4 years' exp. as draftsman and 6 years' practice in various shops, here and in Europe, desires position; prefers marine engines, machine shop tools or locomotive works. Box 142, AMERICAN MACHINIST.

Help Wanted.

Wanted—In Boston, Mass., a stenographer familiar with mach. tools and office work. Box 132, AM. MACH.

Wanted first-class erecting shop foreman. Address the Bucyrus Company, South Milwaukee, Wisconsin.

Wanted pattern tender; one used to foundry and patterns; steady position. Address, Box 134, AM. MACH.

Wanted—First-class draftsman, one who has had experience on traveling crane work preferred. Box 135, AMERICAN MACHINIST.

Wanted—Draftsman, exp. in steam pumping mach. located in Ohio; state experience and salary expected. Box 138, AMERICAN MACHINIST.

Wanted a practical mach. capable of handling all tools in modern machine shop; state full information. Box 137, AMERICAN MACHINIST.

Wanted an instructor in pattern making and foundry work. Address, stating experience, age, salary, etc., Box 94, care of AMERICAN MACHINIST.

Wanted, draftsman with thorough experience in machine tools and automatic machinery of hopper feed class. Box 140, AMERICAN MACHINIST.

Wanted—First-class tool-maker; give past connections, kind of work engaged upon and wages expected. Bickford Drill & Tool Co., Cincinnati, Ohio.

Wanted—Salesman of experience on pulleys and transmission machinery in vicinity of New York. Must have a record. Box 133, AMERICAN MACHINIST.

We want a competent boiler-maker, capable of estimating contract work, to take charge of our boiler shops. The Murray Iron Works Co., Burlington, Iowa.

Wanted at once 20 first-class machinists, accustomed to large engine work or heavy machine tools, for night work. Driggs-Seabury Gun and Arm Co., Derby, Conn.

Wanted—A mechanical engineer with improved special machinery to build, would like to correspond with parties in need of a first-class manager. Address, Box 149, AMERICAN MACHINIST.

Wanted—Draftsman capable of designing automatic textile mach. and special tools and jigs for manufacturing; state age, experience and salary. Address, Box 136, AMERICAN MACHINIST.

Wanted die maker to take charge of department; must be thoroughly exp. on irregular and round dies for tinware, cans, etc.; state experience and wages. Box 146, AMERICAN MACHINIST.

Wanted—A thoroughly competent man to take charge of the armature and field winding department of one of the leading electrical companies; with application state experience, what wages would be exp. and also if now eng. in this work. Box 139, AM. MACH.

Wanted by an established concern a machinist, molder and pattern maker who can together raise $5,000; must be first-class men, competent to take charge of their respective departments; dividend guaranteed; none but first-class men of sober and steady habits need make application; work in general mill and mining machinery. Ad. Opportunity, AM. MACH.

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Lathe and planer. 7 Quay street, Buffalo.

Book, Dies & Die Making, $1. J. L. Lucas, Prov. R. I.

Wanted—Small second-hand foot power lathe. Box 132, Dorchester, Wis.

For selling or buying tools apply J. Klein, South Parade, Manchester, England.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Emery Wheel Dressers; send for sample and price. Manufactured by Geo. H. Calder, Lancaster, Pa.

For Sale—Second-hand drill presses, engine lathes and planers. Dietz, Schumacher & Boye, Cincinnati, O.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Several lathes and drill presses nearly new at very low figures for cash Wallace H. Mansfield, New Haven, Conn.

Machinery dealers wanted as agents in New York, Boston and Philadelphia to handle our automatic engines, etc. Clark Bros., Belmont, N. Y.

Wanted complete equipment of machine shop tools, including lathes, planers, drill presses and boring machines. Address F. C. Austin Mfg. Co., Chicago, Ill.

Lathes, planers, drills, milling machines, vises, also brass working machinery second-hand; must be modern and in first-class condition. C. C. Wormer Machinery Co., Detroit, Mich.

Wanted—Salesman calling on machine shops, electric light plants; mechanics and draftsman to carry a first-class specialty; new thing; good profits. Columbus Engineering Co., Columbus, Ohio.

If you use Brass, Bronze or Composition Castings in large quantities, write to us for prices. Jas. J. McKenna & Bro., 424 and 426 East Twenty-third street, New York. Established 1833.

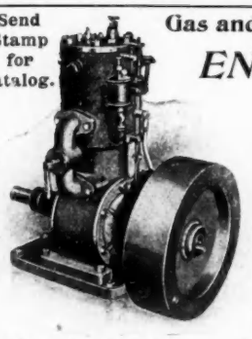
Manufacturer desiring a specialty should investigate small auto. refrigerator machine using no ammonia; four patents pending; no experimental work required; best reference. Refrigerator, AM. MACH.

The advertising department of the American Machinist has on hand 20,000 drafsman's thumb tacks; will send a box of ten to any draftsman in America on request; could use a postage stamp on box, but will send the tacks anyway.

Wanted agency for England for thoroughly first-class feed water purifier and scale preventer. Advertisers have splendid connections among manufacturers. Full particulars to Filter, c. Messrs. C. Mitchell & Co., Red Lion Court, Fleet Street, London, England.

Brains and hands do their best work in the field of their experience. The Century Machine Co., 576 West Broadway, New York, employs trained brains and trained hands in the persons of mechanical experts who are competent to solve intricate mechanical problems and make operative models. The designing of automatic and labor saving machinery is in charge of Mr. Oluf Tyberg and assistants. The Century Machine Co. is equipped with most modern tools as well as men. Light machine work, experimental work, model making and manufacturing solicited.

Send Stamp for Catalog.



Gas and Gasoline

ENGINES.

Both Stationary and Marine.

Engine Castings

Dynamo and Motor Parts and Complete Machines. Electrical Supplies, Telephones.

MIANUS ELEC. CO., Box A, Mianus, Conn.

MODERN AND EFFICIENT

ELECTRIC LIGHTING and POWER TRANSMISSION SYSTEMS

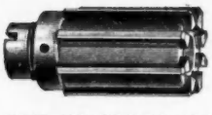
For Mills and Factories.

SLOW SPEED POWER GENERATORS.
MULTIPOLAR and BIPOLAR DYNAMOS and MOTORS.
CLOSED IRONCLAD MOTORS, for dusty or wet places.

Write for descriptive bulletins.

The C & C ELECTRIC COMPANY.

GENERAL OFFICES:
143 Liberty Street, NEW YORK.

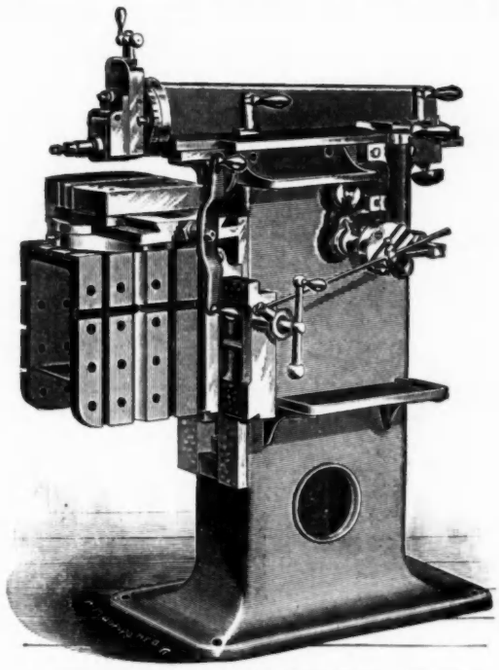


ADJUSTABLE REAMERS.

2 Styles Shell.
1 Hand Reamer.

SOLID AND SPECIAL REAMERS AND TOOLS MADE TO ORDER. Send for Catalogue of Small Tools, free.

R. M. CLOUGH, Tolland, Conn.



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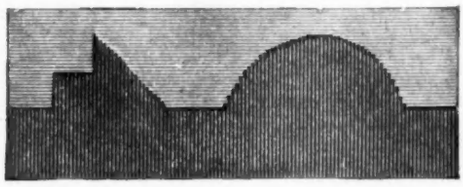
15-inch Hendey Shaper.

Latest Improvements.
Useful Attachments.
Strong and Powerful.

...FOR...

Die Work, Tool Room or General Shop Work.

The stroke can be adjusted for curves with machine in motion. The stroke can be adjusted for angles with machine in motion. The stroke can be adjusted for irregular work with machine in motion. It has adjustable table for planing taper work; table can be removed for fastening work to apron. Has a strong graduated swivel vise. Quick work, rapid changes, modern ideas.



This cut shows how the stroke can be adjusted with machine in motion by micrometer; adjustment fine and delicate SEND FOR CIRCULAR.

THE HENDEY MACHINE CO.

TORRINGTON, CONN.

Agents for the Pacific Coast—PACIFIC TOOL AND SUPPLY COMPANY San Francisco, Cal.
J. W. CREGAR Philadelphia Bourse Exhibition

European Agents: SCHUCHARDT & SCHUTTE Berlin, Vienna, Brussels Stockholm.
CHAS. CHURCHILL & CO., Ltd., London and Birmingham, Eng.
ADPHE. JANSSENS, Paris, France.

Continued from page 36.

weeks and see what the result of the agitation will be before putting out their money is inevitable, and this would especially be the case with capitalization and bonding schemes. But the engineering end of enterprises that have already secured their capital is less likely to be affected by it now.

In the water tube boiler market sharp competition between the two companies which have been engrossing the field of late still goes on. One of these two contestants secured the contract to furnish 14,000 horse-power of boilers for the new Metropolitan power house. This is but a small fraction of what will be required eventually. A sad commentary upon the ruthless competition in boilers is the fact that a water tube boiler company has gone into the hands of a receiver, and when we called at its New York office this week the name had just been removed from the door.

A pump company which makes a specialty of marine work says that there is an improvement in that line at present, and not altogether among war vessels either. Another pump company has not noticed any immediate increase in the marine demand, but says that it has been greater for the past year or so. At this season, as is natural, several good water works contracts are being placed.

CONTRACTS—PAST AND FUTURE.

Engines aggregating 260 horse-power are about to be purchased for the Wool Exchange Building, this city, and it is said that about everybody in the engine business is putting in bids. Our informant, however, is not doing so, because the concessions made in some of the bids are too low. It seems that some Western parties are trying to get an introduction into this locality, and are willing to "bear" the market for the purpose. The Western Electric Company, of New York, will put in two 600 horse-power engines and two 400 kilowatt generators. The engines are said not yet to have been ordered, though the dynamos will presumably be of its own manufacture.

Sixteen hundred horse-power of boilers are wanted for the courthouse in Baltimore, Md. For what is said to be the largest office building in St. Louis 450 horse-power of Weston compound engines have been ordered. An ice plant in Brooklyn and a smelting works in New Jersey are recent purchasers of Oil City boilers.

An export house was expecting this week to put out a contract for two large boilers and an engine, aggregating $10,200 in value, for shipment to the Argentine Republic. Cable advices were received by a banking firm a few days ago to close a contract for three large engines of the Corliss pattern, worth over $25,000.

Two 2,500 horse-power Allis engines

contracted for by the Brooklyn Heights Railroad are just being put in, and an engine seller who was over there the other day was greatly impressed by the orderliness and cleanliness of the plant as compared with the state of affairs existing in smaller ones. Certainly the introduction of large units and automatic methods of maintenance renders engineering much more attractive from an æsthetic standpoint.

SOME FAVORABLE REPORTS.

Westinghouse, Church, Kerr & Co. still consider business very satisfactory. We may add that during many months past it has been well understood among the trade that the Westinghouse engines were among the makes selling most freely.

The Pierce & Miller Engineering Company reports continued activity, with generally improving conditions in export trade. It has just installed a large and unique foreign railway plant.

The Watertown Steam Engine Company notices a continued improvement in this locality since the first of the year. Its shops are very busy.

The Abendroth & Root Manufacturing Company is experiencing decidedly improved conditions in the boiler trade. A feature of it at present is that the orders received come from old customers. The lines of industry represented in the purchases are paper, electric lighting and Portland cement. The company has also received a contract recently let by the No. 2 Mills Hotel of this city for 400 horse-power of boilers.

MISCELLANEOUS.

In the Cincinnati report contained in the last issue of our paper were mentioned the names of several manufactories of machinery in that city that were being improved by additions or new plants. Two more may be added to the list. The Cincinnati Milling Machine Company has just purchased some property adjoining its present works, and will erect upon it new shops sufficient about to double the present capacity of its establishment. Wm. E. Gang & Co. are also obliged to extend their plant.

The Morse Twist Drill & Machine Company, New Bedford, Mass., is running twelve and a half hours per day and trying hard to take care of customers by filling orders promptly. It is constantly purchasing new machine tools and designing and building them for itself.

▲ ▲ ▲

Quotations.

NEW YORK, Monday, March 14.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$11 00	@	11 50
No. 2 foundry, Northern	10 50	@	11 00
No. 2 plain, Northern	10 00	@	10 50
Gray forge, Northern	10 00	@	10 50
No. 1 foundry, Southern	10 75	@	11 00
No. 2 foundry, Southern	10 25	@	10 50
No. 3 foundry, Southern	10 00	@	10 25
No. 1 soft, Southern	10 75	@	11 00
No. 2 soft, Southern	10 25	@	10 50
Foundry forge, Southern	9 75	@	10 00

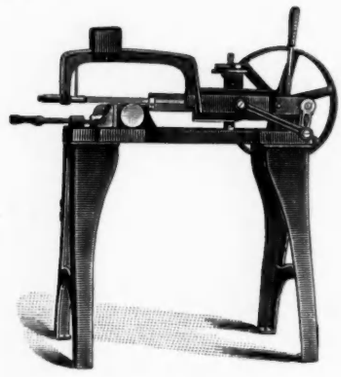
Bar Iron—Base—Mill price, in carloads, on

"The best is as good as any."

The New

Automatic and Gravity Feed

Q & C Shop Saw



Cuts { Tool Steel, Machinery Steel, Iron, Brass and All Other Metals.

Price—'Way Down.
Quality—'Way Up.

Shop Saws,
Portable Rail Saws,
Cold Power Saws,

For All Purposes.

Send for Catalogue.

Q & C Company,

Chicago. New York.

LONDON: Chas. Churchill & Co.
PARIS: Hounsfield & Fils.
BERLIN: Schuchardt & Schutte.
MADRID: J. G. Neville & Co.

A GOOD OIL. Read Redwood's New Book, $1.50.
SPON & C., 12 Cortlandt St., New York.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD, CONN.

J. M. ALLEN, President.
WM. B. FRANKLIN, Vice-President.
F. B. ALLEN, Second Vice-President.
J. B. PIERCE, Secretary and Treasurer.

PLANER

WANTED.

32 in. x 32 in. x 24 ft. to 50 in. x 50 in. x 30 ft.

MUST BE IN GOOD ORDER.

Box 148, American Machinist.

CLEANED WITHOUT ALTERING ADJUSTMENT

THE LEVER RULING PEN

SEND FOR DESCRIPTIVE CIRCULAR.
THEO. ALTENEDER & SONS, PHILADELPHIA.

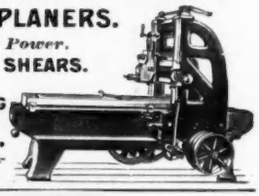
CENTURY MACHINE CO., Machinists, Manufacturers, Model Makers and Contractors.

OLUF TYBERG, Mechanical and Consulting Engineer.

Both at 576 West Broadway, New York.

THEY WORK TOGETHER OR INDEPENDENTLY.

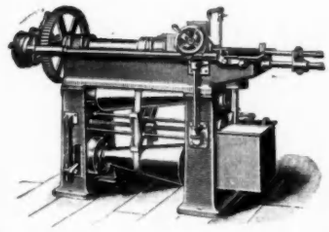
WHITCOMB PLANERS.
Hand and Power.
PUNCHES AND SHEARS.
WHITCOMB MANUFACTURING COMPANY.
Worcester, Mass.
English Agts., Selig, Sonnenthal & Co., London.



R. POOLE & SON CO.
ENGINEERS, FOUNDERS AND MACHINISTS.
BALTIMORE, MD.
MANUFACTURERS AND DESIGNERS OF ALL KINDS OF
HEAVY MACHINERY,
REQUIRING FIRST CLASS WORKMANSHIP AND MATERIALS
HAND & ROPE AND FLY WHEELS. FRICTION CLUTCHES. PULLEYS, SHAFTING AND HANGERS.
MACHINE MOLDED AND PLANED GEARING.
POOLE-LEFFEL TURBINE WATER-WHEELS.
CIRCULARS ON APPLICATION.

CUTTING-OFF LATHES

With automatic feed and stop motion, in four sizes, for ¼ to 4½ inch diameters, without and with mechanism for quickening motion of the spindle and feed as the tool advances toward the center of the work.



2 SPINDLE CENTERING MACHINES, in 2 sizes.

SHAFT DRILLING AND GEAR CUTTING given special attention.

Ask for the Machinists' Catalogue.

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THE PRATT & WHITNEY COMPANY,

HARTFORD, CONN., U. S. A.

NEW YORK: 123 Liberty St. BOSTON: 144 Pearl St. CHICAGO: 42 South Clinton St. LONDON, England: Buck & Hickman, 280 Whitechapel Road. PARIS, France: Fenwick Freres & Co., 21 Rue Martel.

2,000 Engravings,

all sorts of tools, ought to be at your elbow always. The Tool Catalogue, 25 cents.

Montgomery & Co., The Tool Dealers,

P. O. Box 971, New York City.

DRILLS FOR LIGHT WORK.

We make drills from one to eight spindles, hand and automatic feed. Send for price of the

"W. & R. Special"

Double Head Traverse Drills; also Adjustable Two-Spindle Drills, Tapping Machines, Cutter Grinders, Surface Grinders, Centering Machines. Write for Catalogue.

WOODWARD & ROGERS,

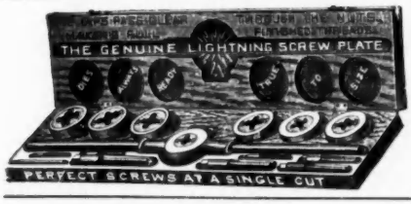
HARTFORD. - - - CONN., U. S. A.

European Agents: SELIG, SONNENTHAL & CO., London, England; E. SONNENTHAL, JR. Berlin, Germany.

STEAM BOILERS

PEABODY & MILLER,	$4.00
FLATHER & WILSON,	2.50
THURSTON BOILERS,	5.00
THURSTON BOILER TRIALS,	5.00

JOHN WILEY & SONS, 53 East 10th St., New York.



FINE SCREW PLATES.

"Lightning" and "Green River."

Taps, Dies, Reamers Tap Wrenches, Bolt Cutters, Drilling Machines, Punching Presses and other labor saving Tools. SEND FOR CATALOGUE.

Wiley & Russell Mfg. Co.,

Agents in London: SELIG, SONNENTHAL & CO., 85 Queen Victoria Street.

Greenfield, Mass., U. S. A.

Jenkins Standard '96 Packing

weighs 33-1/3 per cent. less, does not **Rot, Burn** or **Blow Out,** and will last longer than other joint packings; therefore the cheapest and best for all purposes.

Good buyers compare weights.
Genuine stamped like cut.

JENKINS BROS., New York, Boston, Philadelphia, Chicago.

HUGH HILL CUT-OFF TOOL.

Made in all sizes and using self-hardening steel blades. **HUGH HILL TOOL CO., Anderson, Ind.**

THE BENTEL & MARGEDANT COMPANY

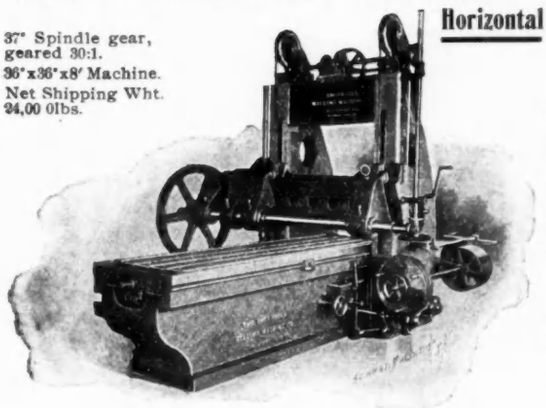
MANUFACTURERS OF WOODWORKING MACHINERY

HAMILTON, O. U.S.A.

HEAVY MILLING MACHINES EXCLUSIVELY.

Horizontal or Vertical Spindles or Both

37" Spindle gear, geared 30:1.
36"x36"x8' Machine.
Net Shipping Wht. 24,00 0lbs.



SIZES:
15", 20", 24", 36", 48", 60", any length.

Wide range of cutter speeds.
Variable table feed from 3-16" to 10" per minute.
Power elevating and lowering device.
Table adjusted by power in either direction.

Write for full information and prices to

The Ingersoll Milling Machine Co.

P. O. Box 2777,

ROCKFORD, ILL., U. S. A.

FOREIGN AGENTS:
C. W. Burton, Griffiths & Co., London, Eng.
A. Janssens, Paris, France.
DeFries & Co., Berlin and Dusseldorf.

EASTERN BRANCH,
126 Liberty Street, New York.

Cable Address: "Ingersoll," Rockford.

Quotations continued.

dock: Common, 1.07½ @ 1.10c.; refined 1.15 @ 1.20c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.30 @ 1.50c.

Tool Steel—Base sizes, standard quality, 6 @ 7c., with some grades perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, in small lots, 1.45 @ 1.60c.

Cold Rolled Steel Shafting—Base sizes, from store, in retail lots, 2.15 @ 2.20c.

Copper—Carload lots: Lake Superior ingot, 12c.; electrolytic, 11¾c.; casting copper, 11½ @ 11⅝c.

Pig Lead—Carload lots, 3.70 @ 3.75c., f. o. b. New York.

Pig Tin—For 5 and 10 ton lots, 14.35 @ 14.40c., f. o. b.

Spelter—Carload lots 4.20 @ 4.25c., New York delivery.

Antimony—Cookson's, 8⅛c.; Hallett's, 7¾c.

Lard Oil—Prime City, present make, 44 @ 46c., in wholesale lots.

▲ ▲ ▲

Manufacturers.

The St. Louis, Mo., Milling Company is erecting a new plant.

The Reading Iron Company, Reading, Pa., is constructing a new blast furnace.

The Consolidated Railway Company, of Baltimore, Md., is having a new boiler house erected. Tex.

The Portland Cement Company at Mosherville, Mich., expects to expend $100,000 on its plant.

Elmer E. Smith, of Wurtsboro, N. Y., has purchased some land on which he is to erect a factory.

At Washington, D. C., the Denham Machine Company has been granted a charter of incorporation.

A stock company is being organized at Eaton Rapids, Mich., for the establishment in the city of a bell foundry.

The plant of the Brazil Pottery and Clay Manufacturing Company, Brazil, Ind., was totally destroyed by fire recntly.

The People's Electric Light and Power Company, of Newark, N. J., is erecting a new power house, 170x74 feet in dimension.

The University of Tennessee, Knoxville, Tenn., will soon install foundry outfit; also engine and boiler for the mechanical department.

J. Frank Curry, of Wilmington, Del., is very largely interested in the establishment of a machine-made mortar plant at Baltimore, Md.

It is expected that extensive improvements will be made to the plant of the Citizens Electric Light and Power Company, of Houston,

The Sweets Steel Company, of Syracuse, N. Y., has been incorporated to manufacture steel goods; capital, $100,000. Directors: A. N. Palmer, J. W. Smith, Ethel Sweet, J. S. Finch and Peter Eckel.

The Herschell Manufacturing Company is the title of a new company organized at Princeton, Ind., with a capital stock of $20,000. They will build shops and devote themselves to the manufacture of the Herschell flue welder.

Mr. J. S. Minor, of the well-known distillery contracting firm of J. S. Minor & Sons, Louisville, Ky., sailed last Wednesday for Caracas, Venezuela, to form his plans for the building of a distillery to be owned and operated by the American Spirits Manufacturing Company.

The Mt. Holly Brick & Clay Company, of Harrisburg, Pa., with an authorized capital of $200,000, has just been organized and a charter will be applied for at once. The works will be located at Mt. Holly, in Cumberland County. The plant will be equipped with modern machinery.

The Jenkins Rubber Company, Elizabeth, N. J., filed its certificate of incorporation recently. The company will engage in the manufacture of rubber fabrics from the raw material, and will begin business with a capital of $30,000. The shareholders and incorporators are Alfred B. Jenkins, West Orange; James L. Davis, Holyoke, Mass.; Henry D. Gordon, East Orange, N. J.; Frank T. Swain, Philadelphia; Joseph J.

Miller, Chicago; Paul H. Smith, Brooklyn; Patrick J. Lynch, Holyoke, Mass.

The Reading (Pa.) Iron Company is about to remodel its pipe mill. New furnaces are to be introduced.

Schnorr Bros., of Manitowoc, Wis., whose tannery was destroyed by fire last fall, contemplate the rebuilding of their plant on a larger scale.

The Stamford, Va., Dye Works have been destroyed by fire. Loss, $100,000; partly covered by insurance. The property was owned by the Stamford Manufacturing Company, of Stamford, Conn.

Plans have been made for a brick, iron and stone cotton mill, 100x200 feet, to be built at Norristown, Pa., by a stock company. It is to be fitted with steam heat and power, electric work and general appliances.

Architect Thomas Stephen, of Camden, N. J., has plans completed for a factory to be built at Delaware and Cooper streets, in that city. It will be of iron, brick and stone, four stories high, 50x150 feet, and be fitted up with all modern conveniences.

Extensive improvements are now being made at the big iron plant of Moorhead, Brother & Co., Sharpsburg, Pa. A new iron skelp mill is being built, and the plant expects to be able to turn out iron skelp up to 18⅞ and 20¾ inches in width in grooves. New machinery is also to be installed.

In a recent issue we published an item to the effect that the New York Car Wheel Works, of Buffalo, N. Y., would establish a new plant at New Castle, Pa. We have since received information from this company that this is a mistake, and it is not their intention to erect such a plant.

The Gathmann Gun-Torpedo Company, Chicago, has been incorporated by H. Y. McMullen, Winsor Chase and Louis F. Mann. The company is to manufacture guns, torpedoes, projectiles and ordnance generally. Louis Gathmann, the inventor, and his son, Emil are interested in the concern.

The Derbyshire Falls Stone and Cement Company, of Indianapolis, Ind., has been incorporated. The capital stock is $50,000. Directors: John O'Hair, J. W. Pusey, J. B. Pusey, E. C. Minton, C. W. Pusey, J. R. Boyd, F. W. Pusey, Oscar Derbyshire, J. M. Whedon and S. E. Thomas.

C. W. Howard, of Neenah, this morning awarded to C. B. Pride the contract for the immediate construction of a six-ton tissue paper mill at Appleton, Wis. The mill will be run in connection with Mr. Howard's paper mill. The building will be of brick and stone, 50x120 feet and two stories in height.

The Yawman & Erbe Manufacturing Company, of Rochester, N. Y., has been incorporated to manufacture and deal in metallic, wooden and paper goods. Directors, Fred. Wagner and Samuel E. Watson, of New York city; P. H. Yawman, of 168 University avenue, and Chas. Slemin, Jr., of Chicago, Ill.

Another large pearl button factory will be started at Vinton, Ia., by the Waterbury Button & Electric Company, of Waterbury, Conn., and local capitalists. The brick building has been bought, and it will be modernized and equipped with the latest machinery. The capital of the new company will be $20,000.

The Lancaster, Pa., Electric Light, Heat & Power Company, which has the contract for lighting the streets of that city for the ensuing five years, and which is erecting an additional power plant for the purpose of establishing a commercial system, has just purchased a site in the business part of the city for a sub-station. The company will erect a building.

Articles of incorporation have been filed in the Camden, N. J., County Clerk's office by the Bouton Engine Company. The objects of the corporation are to build and erect engines. The capital stock of the company is $50,000. The incorporators are Samuel Bouton, Florian Vurpillot, William Ruwell and Alfred Henwood, of Philadelphia, and C. P. Martindale, of Camden.

Norton Norton Norton Norton Norton Norton

The Walker Cutter and Reamer Grinder.

This illustration shows this grinder arranged for cutter and reamer grinding only, and is designed to fill the demand for a machine not so elaborate as a complete grinder, but so arranged that the different attachments which are interchangeable can be added when desired.

Norton Emery Wheel Co.
Worcester, Mass.

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Did you know

we are selling the latest and best screw-cutting Lathe on the market at a lower price than any other manufacturer? This lathe has 10-inch swing and 25 inches between centers.

Price, during March only, **$80.00**

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CUSHION BEARING GRINDER.

Write for information on its advantages over other grinders.

EMERY WHEELS AND GRINDING MACHINERY.

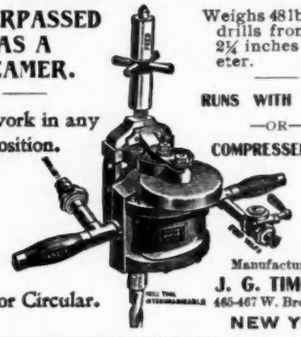
The Safety Emery Wheel Co.
SPRINGFIELD, OHIO.

MOFFET PORTABLE DRILL.

UNSURPASSED AS A REAMER.

Weighs 48 lbs. and drills from ⅛ to 2¼ inches diameter.

Will work in any position.



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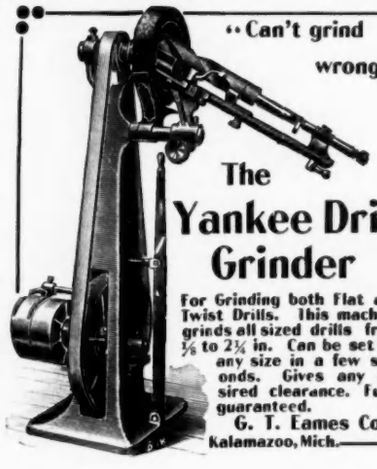
Manufactured by **J. G. TIMOLAT,** 465-467 W. Broadway, **NEW YORK.**

"Can't grind wrong."



The Yankee Drill Grinder

For Grinding both Flat and Twist Drills. This machine grinds all sized drills from ⅛ to 2½ in. Can be set for any size in a few seconds. Gives any desired clearance. Fully guaranteed.

G. T. Eames Co., Kalamazoo, Mich.

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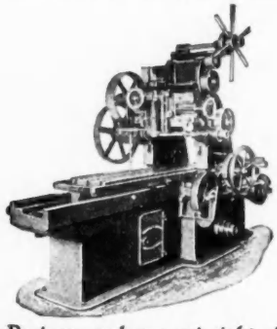
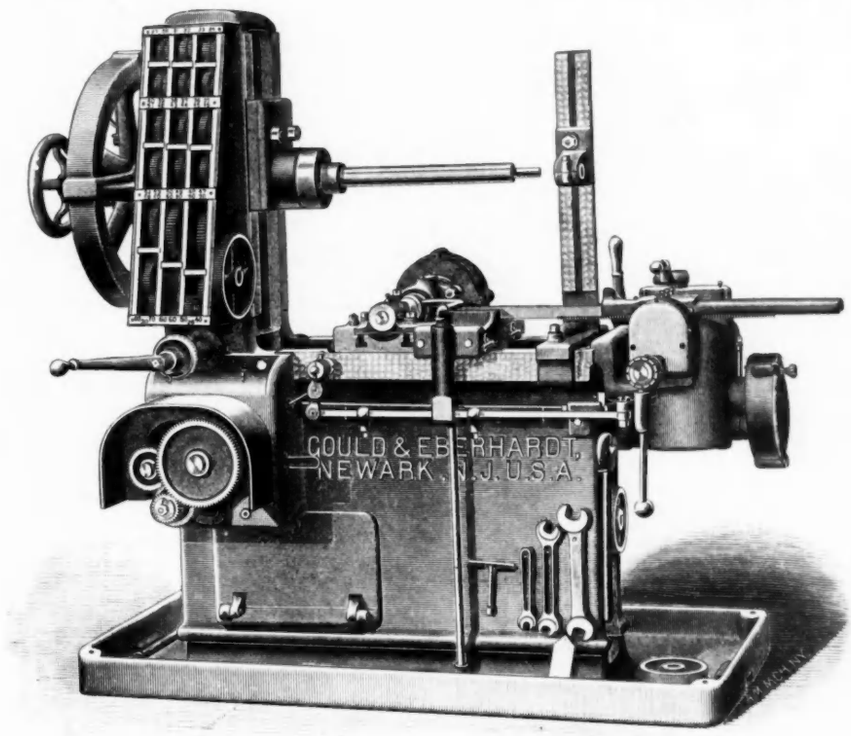


I mean Business, and can cut right along for eight feet. Don't you want me?
I have a BROTHER that can BORE.
Write to BEAMAN & SMITH,
Providence, R. I.



Some of the very good reasons why the "Victoria"

Gear Cutter is considerably better than others.

In the first place it is built by Gould & Eberhardt, who are pioneers in gear cutter making, and their fifty years' of experience in this line has pointed an avoidance of the errors common in others.

This Gear Cutter is absolutely automatic, in every sense of the word, and withal very simple in construction. It is driven by spiral or helical gearing throughout.

Every movement is complete in itself, and unless all previous movements are fully and correctly completed the next cannot take place.

The divisions of the worm wheel must be fully completed before the cutter carriage can commence its work.

The cutter must have traversed its entire length before it can return, and must be back in position ready for the next cut before the next division can be made.

A very essential feature provides that unless the divisions have been made complete the cutter carriage cannot possibly feed forward. This action always takes place entirely automatically and requires no adjustment whatever for any size of gear. This feature prevents the spoiling of gear blanks.

A large feed range and the many possibilities of the dividing mechanism allow for the cutting of any size or pitch of gear within the 33 x 9 inch limit at speeds governed only by the endurance of the cutter used.

Only one belt is used to drive the entire machine.

The pulley shaft is geared direct with the dividing, cutting and driving mechanism, respectively.

This machine will divide and cut all numbers of teeth from 4 to 100, and all from 100 to 450 except the prime numbers and their multiples —others do about 60 per cent. less than this. Take, for instance, the divisions to 100; we cut all from 4 to 100; others cut only 12 to 50 teeth, and divisible ones from 50 to 100.

It does not require an expert to operate this machine.

There is a whole book full of other good reasons why this is the cutter you need.

Made also in 43 in., 53 in., 63 in., 73 in., and 103 in.

Made for Spur, Bevel, Worm and Face Gears, in 22 in., 30 in., 36 in., 50 in., 62 in., 72 in., and 144 in.

Gould & Eberhardt, Newark, N. J.

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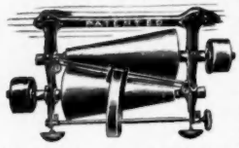

Forty-seven different sizes, transmitting from One to Forty Horse-Power, changing the speed of all kinds of machinery while running. Send for Catalogue. The following is a partial list of manufacturers who have thousands of Evans Friction Cone Pulleys, transmitting from One to Forty Horse-Power:

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WASHBURN & MOEN, Worcester, Mass. A large number.
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Make this fine little hand miller. Weight, 600 lbs. You will be surprised how little money will purchase one.

What makes price so low? you ask. Modern shop, modern facilities, up-to date management. That is the combination that regulates our price.

Nine other sizes, ranging in weight from 600 lbs. to 4,500 lbs.

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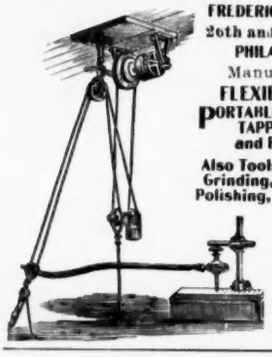
STOW FLEXIBLE SHAFT CO.,



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Machinery for Making Wood Screws.

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All sorts of Parts and Fittings can can be finished to advantage on a

GRINDSTONE

Let us know your requirements, and we will select the grit just suited to your work.

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Manufacture

Milling Machines, Automatic Gear Cutting Machines, Improved Cutter Grinders, Milling Cutters.

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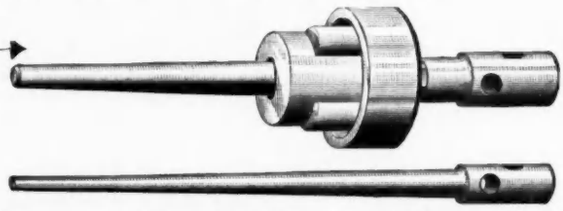
This is

the "double size" expander, which answers for two or more sizes of tubes. Very handy tool for odd sizes of tubes.

Class "E"



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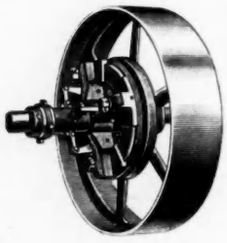

When you want

a Friction Clutch Pulley, you want one that can be depended upon. Life's too short to be given up to monkeying with a clutch, and waiting for a favorable moment to operate it, lest some delicate portion get broken and lost in the shuffle. Frisbie Friction Clutches are designed to be handled roughly and are to be depended upon always. Reading matter ready.

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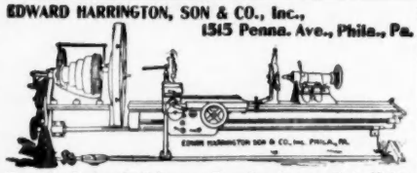

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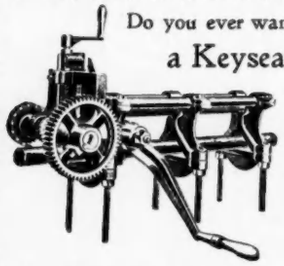

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Takes up to 5-in. shaft. Mills 12 in. long without resetting.

Cuts 3-4 x 3-8 Keyway in an hour. Laborer's job.

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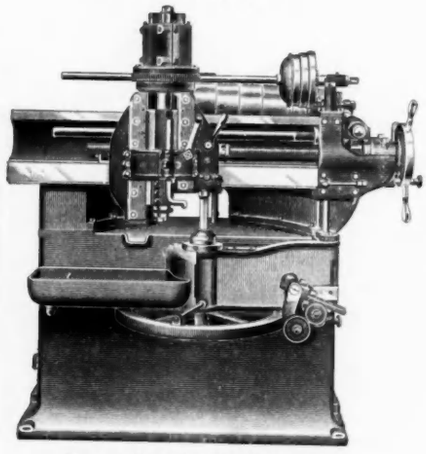
BURR PORTABLE KEYSEATER

A perfect machine, using a cutter distorted in hardening, could not produce still running gears.

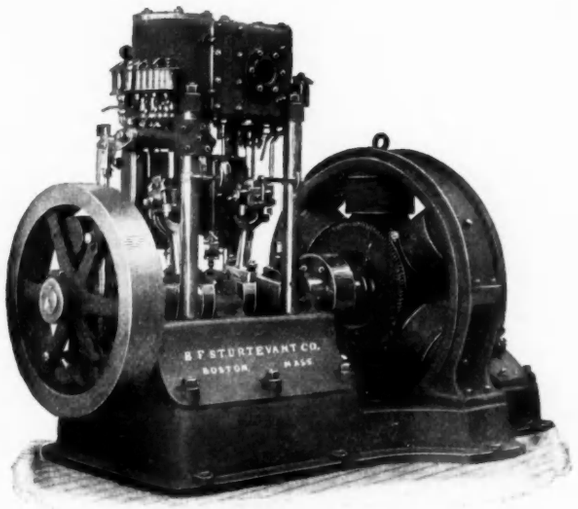


THE FELLOWS GEAR SHAPER

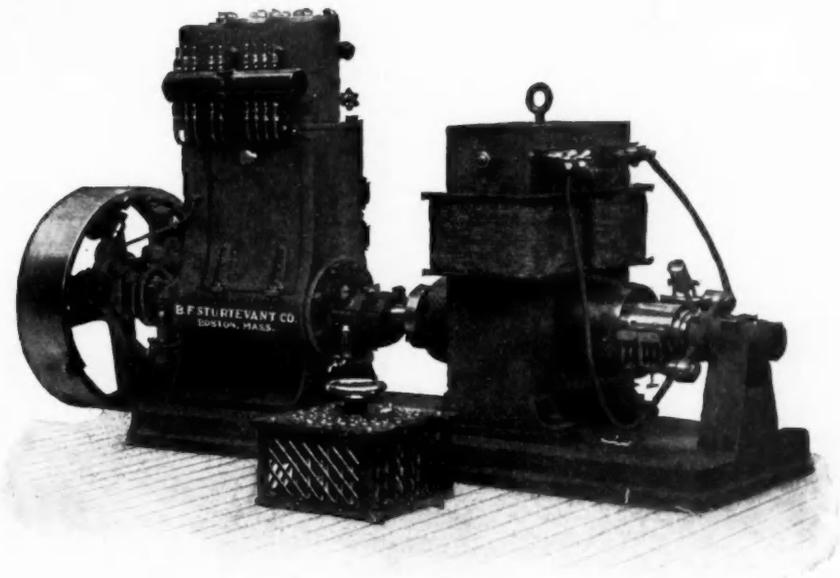
planes theoretically correct gears, because the tooth form of the cutter is ground after it is hardened. Allow us to prove this to you.

The Fellows Gear Shaper Co.,
SPRINGFIELD, VERMONT.

Catalogue free.



The Sturtevant Generating Sets With Automatic Engines.



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Electric Motors and Generators. Sizes up to 80 K. W.

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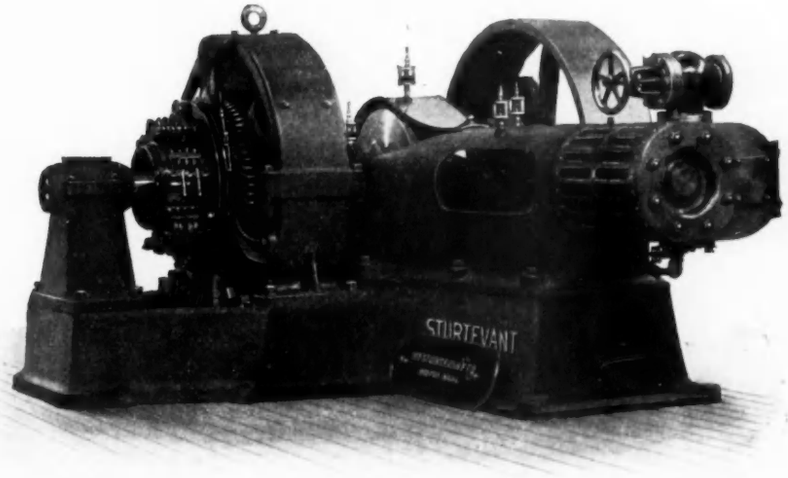

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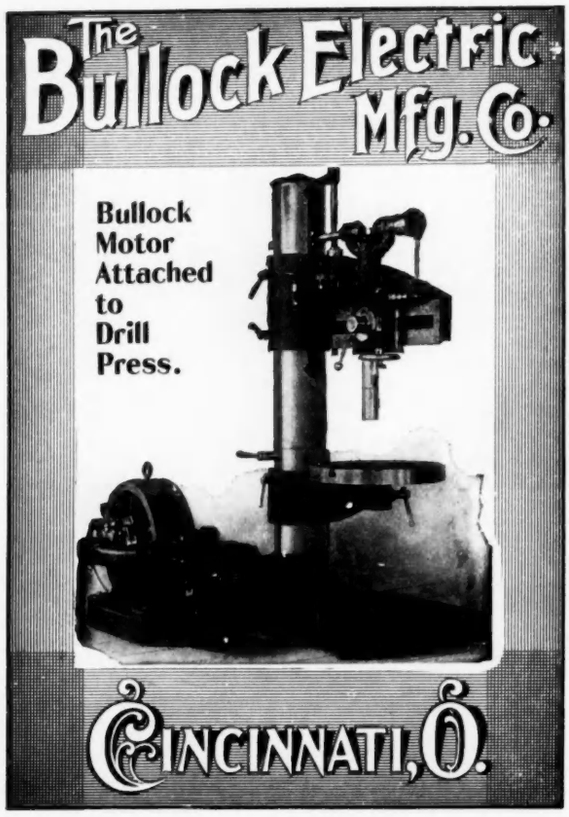

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If Tiffany & Co.

have found it profitable to drive all the machinery and tools in their Forest Hill factory by General Electric Company motors, will it not pay you to go into the question of **ELECTRIC DRIVE** with us? We can convince you of its economy.

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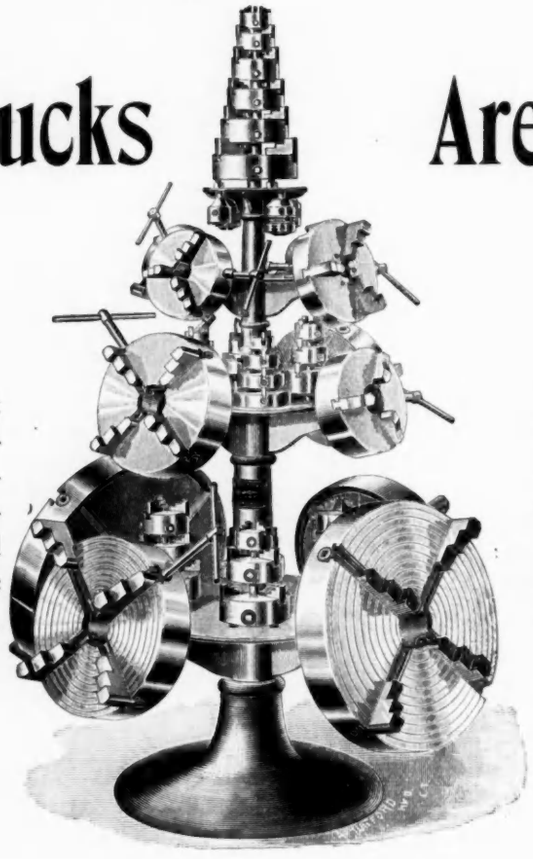

Are not the result of pleasant dreams or haphazard happenings. They are the result of deliberate mathematical precision of design and execution with a definite comprehension of what is needed to make a faultless chuck in every way. Made by D. E. Whiton Mach. Co., New London, Conn. Selig, Sonnenthal & Co., London Agents.

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Cincinnati No. 3 Universal Miller.
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Gould & Eberhardt 36 in. Automatic Gear Cutter.
Gray Planer, 30 in. x 8 ft.
Powell Planer, 42 in. x 14 ft., four heads.
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Bement 500 lb. Steam Hammer.

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One Hornsby-Akroyd Oil Engine of 30 H. P. Has been run only a short time, and guaranteed as good as new. To be sold only for the reason that we have put in a much larger Engine, which renders its continued use unnecessary.

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1 15 in. x 6 ft. Wood & Light.
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1 16 in. x 7 ft. Dustin & Hubbard.
1 18 in. x 8 ft. Dustin & Hubbard.
1 21 in. x 9 ft. Pratt & Whitney.
1 24 in. x 13 ft. Lathe & Morse.
1 27 in. x 10 ft. Dustin & Hub.
1 28 in. x 12 ft. Wood & Light.
1 32 in. x 13 ft. Bement.
1 48 in. x 18 ft. G. & S.
1 Pit Lathe, 72 in. x 18 ft.

PLANERS.

2 16 x 16 in. x 4 ft. Hendey.
1 24 x 24 in. x 6 ft. Powell.
1 24 x 24 in. x 7 ft. Lathe & Morse.
1 28 x 28 in. x 8 ft. G. & S.
1 30 x 30 in. x 10 ft. Niles.
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1 36 x 36 in. x 18 ft., Wm. Sellers.
1 48 x 32 in. x 6 ft. Pond, 2 hds.

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1 22 in. Prentice Bk. G. & P. F.
1 3-Spindle Hendey.
1 No. 3 4-Spindle Garvin.
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1 No. 4 W. & S. Bk. G'd.
1 No. 4 W. & S. and P. F.
1 No. 2 Niles, with tools.
1 18 in. P. & W. Chucking Machine.

MISCELLANEOUS.

1 51 in. Niles B. & T. Mill, 1 head.
1 3 ft. Portable Riveter.
1 Heavy Splitting Shear.
1 Whiton Centering Machine.
1 Circular Shear.
2 Garvin Cutter Grinders.
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3 Bolt Cutters, different sizes.
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New, also nearly good as new. All sizes, immediate delivery.

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Manufacturers,
NEW HAVEN, CONN.

FOR SALE:

1 Gray Lathe, 32 in. swing, 12 ft. bed.
1 Gray Lathe, 20 in. swing, 8 ft. bed.
1 Lodge & Davis, 20 in. swing, 8 ft. bed.
1 Mueller, 18 in. swing, 8 ft. bed.
1 Lodge & Davis, 14 in. swing, 8 ft. bed.
1 Milling Machine; one 18 in. Shaper.
1 Planer, Lodge & Davis, 24 x 24 x 48.
1 2 in. Pipe Cutter, 2 vertical Boring Mills.

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Almost New Machine Tools

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1 Gleason Triple Geared Lathe, 72 in. x 52 ft.
1 " " " " 42 in. x 33½ ft.
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1 Bement-Miles Slotter, 48 in. stroke.
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80 in. x 21 ft. Wilmarth triple geared eng. lathe.
76 in. x 25 ft. Niles Tool Works triple geared eng. lathe, (latest pattern).
44 in. x 18 ft. N. Y. St. Eng. Co. triple gear. eng. lathe.
30 in. x 16 ft. Pond Machine Tool Co. eng. lathe, C. rest and P. C. feed.
22 in. x 18 ft. L. W. Pond eng. lathe, C. rest and P. C. fd.
20 in. x 11 ft. Sellers eng. lathe, C. rest and P. C. feed.
18 in. x 10 ft. N. Y. Steam Eng. Co. eng. lathe, C. rest and P. C. feed.
16 in. x 9 ft. Hendey-Norton eng. lathe, all attachments.
2 16 in. x 8 ft. Bogert eng. lathes, elev. weighted rest.
2 14 in. x 6 ft. Bogert eng. lathes, elev. weighted rest.
2 14 in. x 6 ft. Reed eng. lathes, raise and fall rest.
2 14 in. x 6 ft. Lodge & Davis eng. lathe, raise and fall rt.
1 each 10 in. x 4 and 5 ft. Reed eng. lathe, raise and fall rest.

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42 in. x 42 in. x 12 ft. Gleason, 4 heads, good as new.
42 in. x 42 in. x 16 ft. Bement, 1 head, fair.
30 in. x 30 in. x 8 ft. Wilson, good order.
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24 in. x 24 in. x 6 ft. Lodge & Davis, heavy pattern.
24 in. x 24 in. x 5 ft. Gray, latest pattern.
16 in. x 16 in. x 4 ft. Hendey (has Newell vise), latest pt.
15 in. x 15 in. x 12 in. Blaisdell crank planer.

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17 in. Prentiss Crank, adjustable stroke.
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16 in. Hendey Friction, latest pattern.
13 in. Betts Crank, traveling head.

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6 ft. arm Putnam Radial, heavy pattern.
1 each 3 and 4 ft. arm Betts, good as new.
40 in. swing, Betts, upright, B. G's and P. feed.
36 in. swing, N. Y. Steam Eng. Co., upright B. G's and P. feed.
32 in. swing, Pratt & Whitney, upright, B. G's and P. fd.
26 in. swing, Snyder, upright, B. G's and P. feed.
1 each 1, 2, 3 and 4 spindle, Sensitive, B. G's and P. fd.
3-21 in. Prentice Bros., B. G's and wheel feed.

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No. 2 Cincinnati Universal, B. G's, latest pat., vert. att.
No. 1 Brown & Sharpe Universal, complete with arm.
No. 1 Brown & Sharpe Universal, complete without arm
No. 2 Brown & Sharpe, plain, B. G's, old pattern.
No. 2 Bogert, plain, G. B. G's, heavy.
No. 2 Newton, plain, B. G's, 40 in. table.
25 in. Gould & Eberhardt, aut. gear cutter.
No. 3 Brainard, plain, B. G. miller.
No. 3 Garvin, plain, miller.

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3 large Bliss double crank press., 1 10 in. bet. housings.
No. 3 1-2 Bliss, B. G. double crank press and lot bolsters and die bed, 36 in. hole.
No. 61 Bliss Notching Press, with dial feed and lot dies.
1 each Bullard Armature Winding Lathes, 49 and 33 in. swing.
Style "C" Newark Hor. Boring and Drilling Machine, 3 in. bar, 12 ft. table.
56 in. x 12 ft. Nicholson & Waterman Hor. Boring Machine, good as new.
72 in. Michel Vert. Boring and Turning Mill, 2 heads.
60 in. Bement Vert. Boring and Turning Mill, 1 head.
37 in. Bullard Vert. Boring and Turning Mill, 2 heads.
2 in. Sellers Aut. Bolt Cutter, set taps and dies.
1 1-4 in. Adams Aut. Bolt Cutter, good as new.
18 in. Stroke Putnam Slotter to center 60 in., all feeds.
No. 5, 100 lb. Beaudry Power Hammer.
No. 2 1-2 Pratt & Whitney Screw Mach., W. F. & Fr. hd.
No. 3 Pratt & Whitney Screw Mch., W. F.
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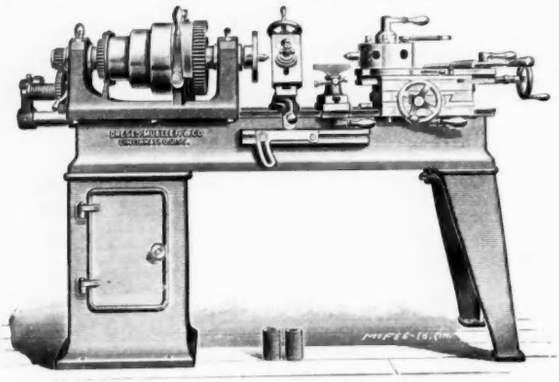

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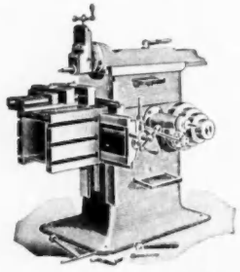

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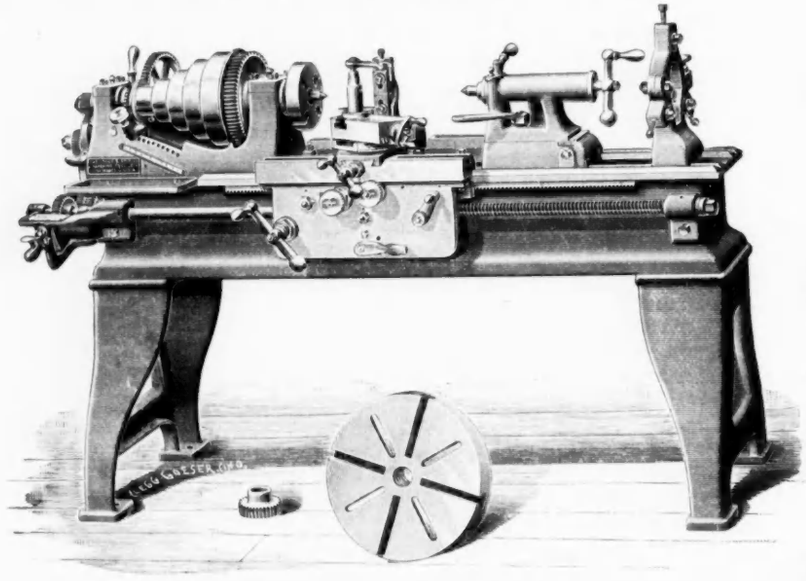

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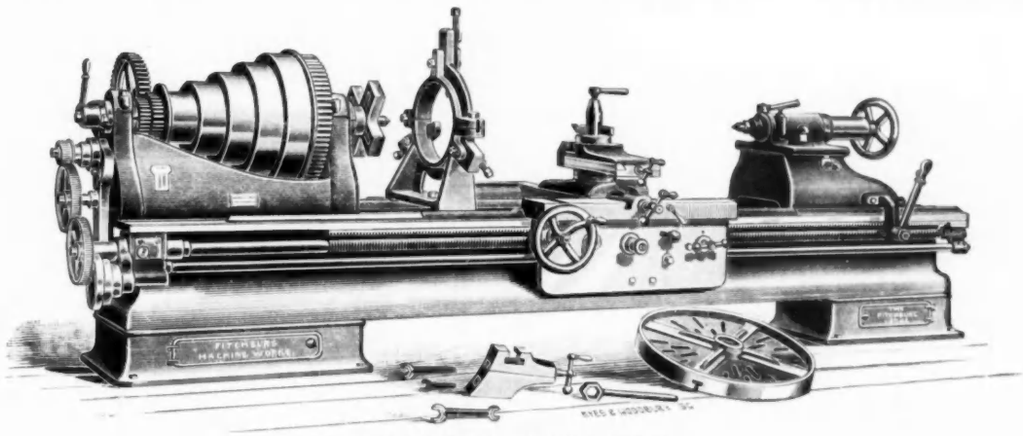

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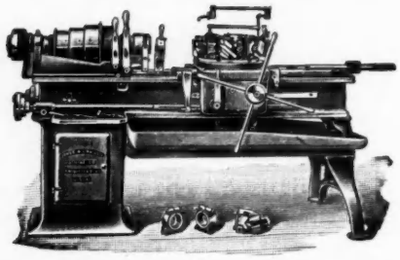

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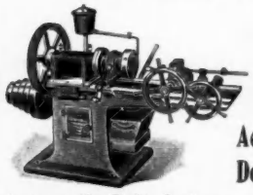

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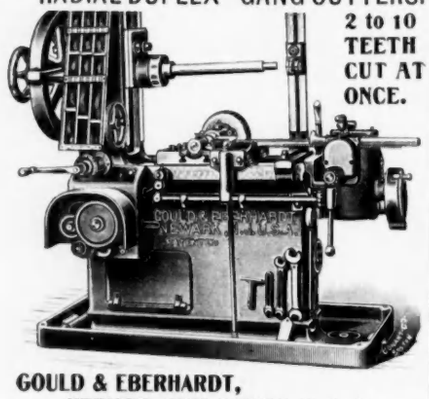

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